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For related information see also *Astronautics.*

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01 AERONAUTICS (GENERAL) 1983

02 AERODYNAMICS 1983

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer*

03 AIR TRANSPORTATION AND SAFETY 1988

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION 1988

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

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05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 1993

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

06 AIRCRAFT INSTRUMENTATION 1995

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 AIRCRAFT PROPULSION AND POWER 1996

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

08 AIRCRAFT STABILITY AND CONTROL 2002

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

09 RESEARCH AND SUPPORT FACILITIES (AIR) 2003

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; space communications, spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*

12 ASTRONAUTICS (GENERAL) 2004

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13 ASTRODYNAMICS 2006

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE) 2006

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

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15 LAUNCH VEHICLES AND SPACE VEHICLES 2006

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

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Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

17 SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING N.A.

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE 2007

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

19 SPACECRAFT INSTRUMENTATION N.A.

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 SPACECRAFT PROPULSION AND POWER 2009

Includes main propulsion systems and components, e.g. rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

CHEMISTRY AND MATERIALS

Includes chemistry and materials (general); composite materials; inorganic and physical chemistry; metallic materials; nonmetallic materials; propellants and fuels; and materials processing.

23 CHEMISTRY AND MATERIALS (GENERAL) 2010

24 COMPOSITE MATERIALS 2010

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

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25 INORGANIC AND PHYSICAL CHEMISTRY 2011

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

26 METALLIC MATERIALS 2014

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 NONMETALLIC MATERIALS 2015

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

28 PROPELLANTS AND FUELS 2018

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

29 MATERIALS PROCESSING 2019

Includes space-based development of products and processes for commercial application.

For biological materials see *55 Space Biology.*

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Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

For related information see also *Physics.*

31 ENGINEERING (GENERAL) 2020

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 COMMUNICATIONS AND RADAR 2020

Includes radar; land and global communications; communications theory; and optical communications.

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Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

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Includes biological, dynamic, and physical oceanography; and marine resources.

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Includes human engineering; biotechnology; and space suits and protective clothing.

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Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 2095
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) 2095
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 2095
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 2096
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 2097
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2098
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2098
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 2100
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 2103
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 2103
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 2104
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL 2105

Note: N.A. means that no abstracts were assigned to this category for this issue.

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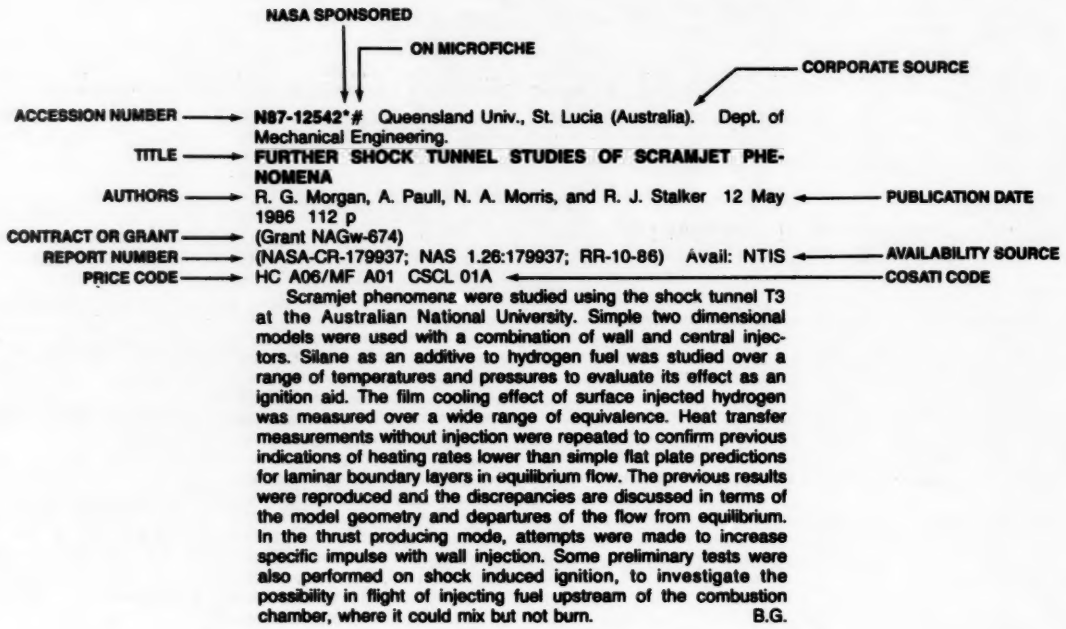
TYPICAL CITATION AND ABSTRACT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CORPORATE SOURCE
ACCESSION NUMBER
N87-12542*# Queensland Univ., St. Lucia (Australia). Dept. of Mechanical Engineering.
TITLE
FURTHER SHOCK TUNNEL STUDIES OF SCRAMJET PHENOMENA
AUTHORS
R. G. Morgan, A. Paull, N. A. Morris, and R. J. Stalker 12 May 1986 112 p
PUBLICATION DATE
CONTRACT OR GRANT
(Grant NAGw-674)
REPORT NUMBER
(NASA-CR-179937; NAS 1.26:179937; RR-10-86) Avail: NTIS
AVAILABILITY SOURCE
PRICE CODE
HC A06/MF A01 CSCL 01A
COSATI CODE
Scramjet phenomena were studied using the shock tunnel T3 at the Australian National University. Simple two dimensional models were used with a combination of wall and central injectors. Silane as an additive to hydrogen fuel was studied over a range of temperatures and pressures to evaluate its effect as an ignition aid. The film cooling effect of surface injected hydrogen was measured over a wide range of equivalence. Heat transfer measurements without injection were repeated to confirm previous indications of heating rates lower than simple flat plate predictions for laminar boundary layers in equilibrium flow. The previous results were reproduced and the discrepancies are discussed in terms of the model geometry and departures of the flow from equilibrium. In the thrust producing mode, attempts were made to increase specific impulse with wall injection. Some preliminary tests were also performed on shock induced ignition, to investigate the possibility in flight of injecting fuel upstream of the combustion chamber, where it could mix but not burn. B.G.

VOLUME 25 NUMBER 15 / AUGUST 8, 1987

Scientific and Technical Aerospace Reports

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01 AERONAUTICS (GENERAL)

N87-21846# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
AIR FORCE TECHNICAL OBJECTIVE DOCUMENT, FLIGHT DYNAMICS LABORATORY PLANS FOR FISCAL YEAR 1988 Final Report, Aug. 1985 - Jul. 1986
Jul. 1986 63 p Supersedes AFWAL-TR-85-3000
(AD-A176115; AFWAL-TR-86-3000; AFWAL-TR-85-3000) Avail: NTIS HC A04/MF A01 CSCL 01C

This document presents an overview of the Laboratory Technology Planning Objectives of the Flight Dynamics Laboratory omitting specific funding and timing information of an Official Use Only nature. Technology planning objectives are described for structures and dynamics, vehicle equipment, flight control, aeromechanics, and technology assessment. GRA

N87-21847# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTA AERODYNAMICA SINICA
6 Jan. 1987 247 p Transl. into ENGLISH of Kongqidongliuxue Xuebao (China), v. 3, no. 4, 1985 p 1-120
(AD-A176552; FTD-ID(RS)T-0368-86) Avail: NTIS HC A11/MF A01 CSCL 20D

Acta Aerodynamica Sinica, v. 3, n. 4, 1985 contains the following: Behavior of Separation Lines in a Steady Viscous Flow Based on Analysis of Boundary Layer Equations; Numerical Prediction of Supersonic Boundary Layer Transition; Iterative Method to Determine Feedback Coefficients for Multiloop Systems; Movement of Hydrometeor Particles in a Bow Shock Layer; Numerical Calculations for Inviscid Transonic Flow Over Two-Dimensional Cascades; Kernel Function Method for Unsteady Transonic Flow Past Low-Frequency Oscillating Bodies of Revolution; Numerical Computation of Turbulent Jet Fields Using Two-Equation Turbulent Model; An Optimal Formulation of Simplified Three-Dimensional Navier Stokes Equations; Numerical Solution of Viscous Flows at Low Reynolds Number; Normal Force Characteristics of Sharp Nosed Bodies of Revolution at High Angle of Attack in Subsonic and Transonic Flow; Method of Differentiating Interpolation Function in Solving Some Partial Differential Equations; Applicability and Linkage of First Order and Second Order Shock Expansion Methods; and the Improvement of Unsteady Aerodynamic Methods for rotor Blade Lift Surface. GRA

N87-21848# Air War Coll., Maxwell AFB, Ala.
FUTURE FIGHTERS: WILL THEY BE SUPPORTABLE?
George T. Babbitt Mar. 1986 26 p
(AD-A177790; AU-AWC-86-013) Avail: NTIS HC A03/MF A01 CSCL 01C

The author discussed requirements for support of future fighters. Conceptual design work is underway for the Advanced Tactical Fighter which the Air Force hopes to field in the mid to late 1990s. Two areas critical to improved supportability are examined: defining the combat environment and improving reliability. Both areas are discussed in terms of new policy guidance and in terms of technical issues now under study. The author concludes that important changes have been made to the way the Air Force approaches the problem of supportability and that research currently underway promises to make future fighters more supportable than current fighters. GRA

N87-21849*# Lockheed-Georgia Co., Marietta.
DEVELOPMENT OF LAMINAR FLOW CONTROL WING SURFACE COMPOSITE STRUCTURES Final Report
L. B. Lineberger et al. May 1984 135 p
(Contract NAS1-17487)
(NASA-CR-172330; NAS 1.26:172330; LG84ER0035) Avail: NTIS HC A07/MF A01 CSCL 01A

The dramatic increases in fuel costs and the potential for periods of limited fuel availability provided the impetus to explore technologies to reduce transport aircraft fuel consumption. NASA sponsored the Aircraft Energy Efficiency (ACEE) program beginning in 1976 to develop technologies to improve fuel efficiency. This report documents the Lockheed-Georgia Company accomplishments under NAS1-16235 LFC Laminar-Flow-Control Wing Panel Structural Design And Development (WSSD); Design, manufacturing, and testing activities. An in-depth preliminary design of the baseline 1993 LFC wing was accomplished. A surface panel using the Lockheed graphite/epoxy integrated LFC wing box structural concept was designed. The concept was shown by analysis to be structurally efficient and cost effective. Critical details of the surface and surface joints were demonstrated by fabricating and testing complex, concept selection specimens. Cost of the baseline LFC aircraft was estimated and compared to the turbulent aircraft. The mission fuel weight was 21.7 percent lower for the LFC aircraft. The calculation shows that the lower fuel costs for LFC offset the higher incremental costs of LFC in less than six months. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N87-21850# Dayton Univ., Ohio.
THE INTEGRAL EQUATION FOR THE TIME DEPENDENT LINEARIZED POTENTIAL FLOW OVER A WING Interim Report, Jul. 1985 - Aug. 1986
Karl G. Guderley and Maxwell Blair Dec. 1986 80 p
(Contract F33615-86-C-3200)
(AD-A176684; AFWAL-TR-86-C-3200) Avail: NTIS HC A05/MF A01 CSCL 01B

This report derives the integral equation for the linearized potential flow over a planar wing which may undergo time dependent deformations. Rigid body motions of the wing are of course included. The final goal is the determination of the time dependent pressure distribution. This report is, however, restricted to the derivation of the formulas necessary for this purpose. For the problem at hand fundamental solutions are available which obviates the need to solve the underlying partial differential equation. The potential is expressed by a distribution of time dependent doublets, initially unknown, over the planform and its wake. The integral equation arises, in principle, by equating the

upwash at the wing due to this doublet distribution with the values derived from the wing deformation. The kernel of this integral equation contains singularities which make this formulation unsuitable for numerical work. This report removes this impediment. GRA

N87-21851# Poseidon Research, Irvine, Calif.
RESEARCH ON POST-STALL AERODYNAMICS Final Research Report, Aug. 1984 - Sep. 1986
R. B. Myers, Z. T. Nguyen, and S. C. Crow Nov. 1986 100 p
(Contract F49620-84-C-0084)
(AD-A177107; RR-83; AFOSR-87-0014TR) Avail: NTIS HC A05/MF A01 CSCL 20D

Fundamental results for two and three dimensional unsteady flows are derived. A model for vortex shedding at salient edges is advanced. A two dimensional Euler solver implementing this vortex shedding mechanism is described. Results of applying this model to impulsively started flat plates with fixed and with oscillating chord at angle of attack are presented. Implications for manipulation of the vortex wake in a post stall maneuver are discussed. A three dimensional unsteady Euler solver based on primitive variables is described. Results of three dimensional computations for delta wing at fixed and time varying angle of attack are presented. GRA

N87-21852# California Inst. of Tech., Pasadena.
THE STRUCTURE AND CONTROL OF A TURBULENT REATTACHING FLOW Ph.D. Thesis
Lorenz Willard Sigurdson 1986 135 p
Avail: Univ. Microfilms Order No. DA8623955

An unsteady and three-dimensional large-scale structure is proposed for the reattachment region of a separation bubble, based on a visualization study of the flow over a plate with a square leading edge and its axisymmetric counterpart, a flat-faced circular cylinder aligned coaxially with the free-stream. The initial free shear layer structures are primarily two-dimensional but evolve into boundary layer type structures as they near reattachment and interact with the wall. An experimental study was made of the effect of a periodic velocity perturbation on the separation bubble downstream of the sharp-edged blunt face of a circular cylinder aligned coaxially with the free-stream. Reattachment length, bubble height, pressure at separation, and average pressure on the face were all reduced. The effects on the large-scale structures were studied on flow photographs obtained by the smoke-wire technique. The forcing increased the entrainment near the leading edge. In both force and unforced cases it was concluded that the final vortex of the shear layer before reattachment is an important element of the flow structure. A method of frequency scaling is proposed that correlates data for a variety of bubbles and supports an analogy with Kalman vortex shedding. Dissert. Abstr.

N87-21853*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SINGULAR FINITE ELEMENT METHODS Final Report
George J. Fix Apr. 1987 35 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178278; ICASE-87-24; NAS 1.26:178278) Avail: NTIS HC A03/MF A01 CSCL 01A

Singularities which arise in the solution to elliptic systems are often of great technological importance. This is certainly the case in models of fracture of structures. A survey of the ways singularities are modeled is presented with special emphasis on the effects due to nonlinearities. Author

N87-21854# Ballistic Research Labs., Aberdeen Proving Ground, Md.
MOMENT EXERTED ON A CONING PROJECTILE BY A SPINNING LIQUID IN A SPHEROIDAL CAVITY
Charles H. Murphy Dec. 1986 58 p
(AD-A177642; BRL-TR-2775) Avail: NTIS HC A04/MF A01 CSCL 20D

The moment exerted by a low-viscosity spinning liquid in a coning cylindrical container has been well predicted by the classical Stewartson-Wedemeyer theory. This boundary layer theory is extended to the case of a completely filled spheroidal cavity, and liquid side moments are computed as functions of fineness ratio and Reynolds number. It is shown that only one eigenfrequency is important for this calculation, and for usual flight coning frequencies, large side moments can only occur for a fineness ratio between unity and 1.5. Author (GRA)

N87-21855*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND-TUNNEL FREE-FLIGHT INVESTIGATION OF A 0.15-SCALE MODEL OF THE F-106B AIRPLANE WITH VORTEX FLAPS
Long P. Yip May 1987 46 p
(NASA-TP-2700; L-16202; NAS 1.60:2700) Avail: NTIS HC A03/MF A01 CSCL 01A

An investigation to determine the effects of vortex flaps on the flight dynamic characteristics of the F-106B in the area of low-speed, high-angle-of-attack flight was undertaken on a 0.15-scale model of the airplane in the Langley 30- by 60-Foot Tunnel. Static force tests, dynamic forced-oscillation tests, as well as free-flight tests were conducted to obtain a data base on the flight characteristics of the F-106B airplane with vortex flaps. Vortex flap configurations tested included a full-span gothic flap, a full-span constant-chord flap, and a part-span gothic flap. Author

N87-21856 Princeton Univ., N. J.
COMPUTATIONAL STUDIES IN LOW SPEED ROTOR AERODYNAMICS Ph.D. Thesis
Todd Randall Quackenbush 1987 211 p
Avail: Univ. Microfilms Order No. DA8702166

Some issues have been addressed by development of curved vortex segments for use in free wake models. These curved elements are assumed to have a parabolic geometry and are fitted to vortex filaments to replace straight elements traditionally used. Substitution allows distorted filaments to be modelled with substantially fewer curved arcs than straight segments. Resulting improvement in computational efficiency is accompanied by more accurate prediction of the local velocity field of vortex. Extensive computational tests were carried out to illustrate improved performance of curved elements. New curved elements have been incorporated into a fullfree wake model suitable for analyzing low-speed rotor behavior. Primary application of this simulation has been prediction of rotor blade flapping motion and associated hub moments at low forward speed (mu less than 0.1 to 0.15). Preliminary validation of code was performed by correlating flapping data from wind tunnel tests of an articulated model rotor. The role of distorted rotor wake in augmenting downwash over the aft portion of rotor disk is analyzed and discussed. Augmentation of downwash is shown to be a key factor in driving the lateral flapping response of rotor. Predictions are made of rotor lateral flapping response in climb and descent, regimes not previous simulated with free wake models. Simulation is also shown to be capable of predicting hub moment response of hingeless model rotor to cyclic and collective inputs at advance ratio .05. Effects of rotor thrust, advance ratio, and climb rate on wake convergence are explored and illustrated. Dissert. Abstr.

N87-21857# Notre Dame Univ., Ind.
THE PREDICTION OF TRANSITIONAL SEPARATION BUBBLES AT LOW REYNOLDS NUMBERS Ph.D. Thesis
Gordon S. Schmidt 1986 194 p
Avail: Univ. Microfilms Order No. DA8702971

In order to predict the aerodynamic characteristics of an airfoil, the boundary layer development along its surface must be accurately determined. Several approaches for predicting the characteristics of separation bubbles were reviewed. These included empirical relationships, numerical solutions of the boundary layer equations, and semi-empirical methods. The latter techniques are particularly attractive because they are simple and yet are based on theory, being solutions to the integral forms of the boundary layer equations. However, their success depends on empirically-founded relationships. The object of the present research was to test these relationships at low Reynolds numbers

and to propose new ones if necessary. This was accomplished by analyzing measurements of separation bubbles formed on an NACA 66 sub 3-018 airfoil at chord Reynolds numbers ranging from 500,000 to 200,000. The data studied consisted of velocity profiles obtained in the vicinity of the separation bubbles as well as flow visualization and surface pressure measurements. Analysis of the data revealed a significant Reynolds number influence on the evolution of laminar separated flow. Dissert. Abstr.

N87-21858*# Lockheed Missiles and Space Co., Huntsville, Ala. Engineering Center.

WIND TUNNEL TEST IA300 ANALYSIS AND RESULTS, VOLUME 1 Interim Report

P. B. Kelley, W. B. Beaufait, L. L. Kitchens, and J. P. Pace Jan. 1987 128 p

(Contract NAS8-33807)

(NASA-CR-179077; NAS 1.26:179077; LMSC-HEC-TR-D951415-1) Avail: NTIS HC A07/MF A01 CSCL 01A

The analysis and interpretation of wind tunnel pressure data from the Space Shuttle wind tunnel test IA300 are presented. The primary objective of the test was to determine the effects of the Space Shuttle Main Engine (SSME) and the Solid Rocket Booster (SRB) plumes on the integrated vehicle forebody pressure distributions, the elevon hinge moments, and wing loads. The results of this test will be combined with flight test results to form a new data base to be employed in the IVBC-3 airloads analysis. A secondary objective was to obtain solid plume data for correlation with the results of gaseous plume tests. Data from the power level portion was used in conjunction with flight base pressures to evaluate nominal power levels to be used during the investigation of changes in model attitude, eleveon deflection, and nozzle gimbal angle. The plume induced aerodynamic loads were developed for the Space Shuttle bases and forebody areas. A computer code was developed to integrate the pressure data. Using simplified geometrical models of the Space Shuttle elements and components, the pressure data were integrated to develop plume induced force and moments coefficients that can be combined with a power-off data base to develop a power-on data base.

B.G.

N87-21859*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

DEVELOPMENT OF COMPUTATIONAL METHODS FOR UNSTEADY AERODYNAMICS AT THE NASA LANGLEY RESEARCH CENTER

E. Carson Yates, Jr. and Woodrow Whitlow, Jr. Mar. 1987 22 p Presented at a workshop on Future Research on Transonic Unsteady Aerodynamics and its Aeroelastic Applications at the 63rd meeting of the AGARD Structures and Materials Panel, Athens, Greece, 28 Sep. - 3 Oct. 1986

(NASA-TM-89133; NAS 1.15:89133) Avail: NTIS HC A02/MF A01 CSCL 01A

The current scope, recent progress, and plans for research and development of computational methods for unsteady aerodynamics at the NASA Langley Research Center are reviewed. Both integral-equations and finite-difference method for inviscid and viscous flows are discussed. Although the great bulk of the effort has focused on finite-difference solution of the transonic small-perturbation equation, the integral-equation program is given primary emphasis here because it is less well known. Author

N87-21860*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

ON THE NONLINEAR INTERACTION OF GORTLER VORTICES AND TOLLMIEN-SCHLICHTING WAVES IN CURVED CHANNEL FLOWS AT FINITE REYNOLDS NUMBERS Final Report

Q. Isa Daudpota (Exeter Univ., England), Philip Hall, and Thomas A. Zang Apr. 1987 63 p Submitted for publication

(Contracts NAS1-17070; NAS1-18107)

(NASA-CR-178286; ICASE-87-26; NAS 1.26:178286) Avail: NTIS HC A04/MF A01 CSCL 01A

The flow in a two-dimensional curved channel driven by an azimuthal pressure gradient can become linearly unstable due to axisymmetric perturbations and/or nonaxisymmetric perturbations depending on the curvature of the channel and the Reynolds number. For a particular small value of curvature, the critical neighborhood of this curvature value and critical Reynolds number, nonlinear interactions occur between these perturbations. The Stuart-Watson approach is used to derive two coupled Landau equations for the amplitudes of these perturbations. The stability of the various possible states of these perturbations is shown through bifurcation diagrams. Emphasis is given to those cases which have relevance to external flows. Author

N87-21861# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.

BUFFET ONSET MEASUREMENTS ON AN AIRCRAFT MODEL AT TRANSONIC MACH NUMBERS

P. R. Viswanath Apr. 1986 39 p

(NAL-TM-AE-8602) Avail: NTIS HC A03/MF A01

Buffet onset measurements were performed on a low aspect ratio, moderately swept, aircraft model at three transonic Mach numbers in the 1.2 m tunnel. Instrumentation included wing root strain gauges, a wing tip accelerometer, wing trailing edge pressure taps, and standard six component internal strain gauge balance. Results of buffet onset obtained by these different techniques are compared. A discussion of the buffet onset results, as it relates to the main features of the flow on the wing upper surface, is also included. Author

N87-21862# National Aeronautical Lab., Bangalore (India). Fluid Mechanics Div.

ON 3D BOUNDARY LAYER COMPUTATIONS ON SWEPT WINGS

N. R. Subramanian and M. I. James May 1987 26 p

(NAL-PD-FM-8715) Avail: NTIS HC A03/MF A01

A three-dimensional turbulent boundary layer code based on an integral method developed by Cousteix and Aupoix has been made operational on the NAL computer. The turbulent modeling is based on an improved mixing length hypothesis and similarity solutions. This code is developed for a general coordinate system for flows up to Mach number 4 on an adiabatic wall. Two test cases (NLR supercritical wing and ONERA-M6 wing) have been tested using this program. Results for the NLR wing have been compared with the available computer results. Author

N87-21863# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.

ANALYSIS OF TWO-DIMENSIONAL MULTI-COMPONENT AIRFOILS IN VISCOUS FLOWS

H. N. V. Dutt Jan. 1987 127 p

(NAL-TM-AE-8701) Avail: NTIS HC A07/MF A01

A method and computer program for analysis of multicomponent airfoils in subsonic, viscous, attached flows are described. The problem is divided into a number of primary task areas, each requiring mathematical modeling and one or more subroutines along with the necessary interfacing logic for digital computation. These are: geometry definition and geometry preprocessing; inviscid analysis; boundary layer solution; combined solution; and determination of overall loads and moments. The inviscid solution is based on an efficient vortex singularity method. The boundary layer solution is comprised of laminar, transition, and turbulent boundary layers in subsonic flow. The combined solution is computed iteratively using the concept of displacement flux by Preston. The overall loads and moments are computed by integrating the pressures. The code was validated against a number of cases to bring out its capabilities and deficiencies. The results of the study indicate that the multi-element program can provide a valuable insight into a number of areas of high lift airfoil design. Author

N87-21864# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.

LEE SURFACE FLOW OVER DELTA WINGS AT SUPERSONIC SPEEDS: SOME FEATURES OF DIFFERENT TYPES OF FLOW

S. N. Seshadri and K. Y. Narayan Dec. 1986 39 p

(NAL-TM-AE-8612) Avail: NTIS HC A03/MF A01

S. N. Seshadri and K. Y. Narayan Dec. 1986 39 p
(NAL-TM-AE-8612) Avail: NTIS HC A03/MF A01

The features of the different types of flow on the lee surface of delta wings at supersonic speeds were studied in terms of the location of separation and re-attachment lines and shock waves and their variation with Mach number, sweep back, thickness, and angle of attack. The study is largely based on tests on two sets of flat topped delta wing models having sweep back angles of 45, 50, 60, and 70 degrees at freestream Mach numbers of 1.6, 1.8, 2.0, 2.5, and 3.0. The first set of models had a wedge angle normal to the leading edge of 10 degrees while the second set had a wedge angle of 25 degrees. In addition, a 60 degree sweepback delta wing with a wedge angle of 40 degrees was also tested. The results indicate that in the leading edge separated flow region, the location of attachment and secondary separation lines and their variation with the angle of attack depended on the particular type of flow. In the attached leading edge flow region, however, the location of the shock-induced separation line is independent of the particular type of flow. Within each type of flow, the effects of thickness are in general found to be small. Author

N87-21865# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.

LEE-SURFACE FLOW OVER DELTA WINGS AT SUPERSONIC SPEEDS

S. N. Seshadri and K. Y. Narayan Sep. 1986 136 p
(NAL-TM-AE-8610) Avail: NTIS HC A07/MF A01

Experiments were conducted to study the types of flow that occur on the lee surface of delta wings at supersonic speeds. Two sets of flat topped delta wings of different thickness, each with leading edge sweep angles of 45, 50, 60, and 70 degrees, were tested. The measurements, performed at Mach numbers of 1.4, 1.6, 1.8, 2.0, 2.5, and 3.0, included oil flow visualization and static pressure distributions. From these and other existing measurements, the leeside flows were classified into nine distinct types. These types of flows were displayed in a plane of Mach number and angle of attack normal to the leading edge. The experimental results indicate that increasing wing thickness has no qualitative effect on the types of flow observed but does shift the boundaries between some of the types of flow. The extensive static pressure data obtained has made it possible to identify each type of flow with a characteristic pressure distribution. The development of the flow as it changes from a leading edge separated type to an attached flow and vice versa was discussed based on the pressure distributions. Author

N87-21866# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.

NONPLANAR VORTEX LATTICE METHOD FOR ANALYSIS OF COMPLEX MULTIPLE LIFTING SURFACES

B. Rajeswari and H. N. V. Dutt Aug. 1986 47 p
(NAL-TM-AE-8606) Avail: NTIS HC A03/MF A01

A method for determining the aerodynamic characteristics of complex multiple lifting surfaces in inviscid subcritical flows was developed and programmed on a UNIVAC 1100/60 computer. Each lifting surface is represented by a network of nonplanar horse shoe vortices distributed on the mean surface and trailing to infinity. The strengths of these vortices are determined by requiring the flow to be parallel to the surface at a number of control points. The force due to a vortex segment is calculated as the vector product of local velocity and the vortex strength multiplied by density. The program can handle wings with breaks and spanwise segmented flaps in leading and trailing edges, local dihedral, camber, and twist. The code can be used to compute lift, induced drag, and pitching moments for any lifting planar or nonplanar surfaces and surfaces in combination like wing-canard or wing-horizontal tail. The program was validated for a number of configurations for which experimental data is available. Author

N87-21867# National Aerospace Lab., Tokyo (Japan). STOL Aircraft Project Group.

PRESSURE MEASUREMENT AROUND THE AFT BODY OF THE NAL STOL-RESEARCH-AIRCRAFT MODEL

1986 18 p In JAPANESE; ENGLISH summary
(NAL-TR-919; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The pressure measurements around the aft body of the NAL STOL Research Aircraft model were carried out in order to explicate the aerodynamic interference between the jet engine exhaust flow and the aft body. Experimental data are useful to comprehend quantitatively the contribution of the aft body to the pressure profile, side force and yawing moment when all engines are operative or an inner engine is inoperative. From the comparison with force tests conducted previously, this quantitative contribution to the whole body was made clear. Author

N87-21868# National Aerospace Lab., Tokyo (Japan).

NUMERICAL ANALYSIS OF INVISCID COMPRESSIBLE FLOWS ABOUT WING-FUSELAGE COMBINATIONS BASED ON THE EULER EQUATIONS

Tomiko Ishiguro, Satoru Ogawa, and Keiko Oguchi May 1986 15 p
(NAL-TR-896T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A numerical procedure based on the Euler equations for analyzing the compressible inviscid transonic flow about a wing-fuselage combination is presented in this paper. In order to treat precisely boundary conditions on the combinational surface and at infinity, the exterior of the wing-fuselage combination in physical space is mapped into a rectangular parallelepiped in a computational space and then a uniform grid is generated there. The Euler equations are solved by the finite volume method using the Runge-Kutta type scheme of the second order accuracy and the local time step technique. Three examples are presented to show the utility of the numerical procedure. Numerical results obtained by the procedure are compared with experimental results and numerical results by the NAL utility code YOKUDO-P based on the full potential equation, and it is shown that the obtained results are in good agreement with the experimental data. Author

N87-21869# National Aerospace Lab., Tokyo (Japan).

COMPARISON OF TRANSONIC AIRFOIL CHARACTERISTICS BY NAVIER-STOKES COMPUTATION AND BY WIND TUNNEL TEST AT HIGH REYNOLDS NUMBER

Naoki Hirose, Nobuhiro Kawai, and Jun-ichi Miyakawa Sep. 1986 17 p
(NAL-TR-911T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The two-dimensional Navier-Stokes code, NSFOIL, is validated in terms of analysis of practical transonic advanced technology airfoil compared to data obtained from wind-tunnel tests. The comparison is carried out at a high Reynolds number of 23 million which corresponds to the actual flight conditions of a transonic transport aircraft. The numerical data show satisfactory agreement in both aerodynamic forces and pressure coefficients, so the code is concluded to be a very effective tool for predicting nonlinear characteristics of transonic airfoils, which has not been possible with any existing inviscid code. In the course of careful comparison, some future improvements of the code are probed in order to obtain even better simulation with this promising computer code. Author

N87-21870*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

EFFECT OF VARYING INTERNAL GEOMETRY ON THE STATIC PERFORMANCE OF RECTANGULAR THRUST-REVERSER PORTS

Richard J. Re and Mary L. Mason Jun. 1987 103 p
(NASA-TM-89061; L-16211; NAS 1.15:89061) Avail: NTIS HC A06/MF A01 CSCL 01A

An investigation has been conducted to evaluate the effects of several geometric parameters on the internal performance of

rectangular thrust-reverser ports for nonaxisymmetric nozzles. Internal geometry was varied with a test apparatus which simulated a forward-flight nozzle with a single, fully deployed reverser port. The test apparatus was designed to simulate thrust reversal (conceptually) either in the convergent section of the nozzle or in the constant-area duct just upstream of the nozzle. The main geometric parameters investigated were port angle, port corner radius, port location, and internal flow blocker angle. For all reverser port geometries, the port opening had an aspect ratio (throat width to throat height) of 6.1 and had a constant passage area from the geometric port throat to the exit. Reverser-port internal performance and thrust-vector angles computed from force-balance measurements are presented. Author

N87-21871*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NEW METHODS AND RESULTS FOR QUANTIFICATION OF LIGHTNING-AIRCRAFT ELECTRODYNAMICS
Felix L. Pitts, Larry D. Lee, Rodney A. Perala, and Terence H. Rudolph (Electro Magnetic Applications, Inc., Lakewood, Colo.) Jun. 1987 67 p
(NASA-TP-2737; L-16281; NAS 1.60:2737) Avail: NTIS HC A04/MF A01 CSCL 01A

The NASA F-106 collected data on the rates of change of electromagnetic parameters on the aircraft surface during over 700 direct lightning strikes while penetrating thunderstorms at altitudes from 15,000 to 40,000 ft (4,570 to 12,190 m). These in situ measurements provided the basis for the first statistical quantification of the lightning electromagnetic threat to aircraft appropriate for determining indirect lightning effects on aircraft. These data are used to update previous lightning criteria and standards developed over the years from ground-based measurements. The proposed standards will be the first which reflect actual aircraft responses measured at flight altitudes. Nonparametric maximum likelihood estimates of the distribution of the peak electromagnetic rates of change for consideration in the new standards are obtained based on peak recorder data for multiple-strike flights. The linear and nonlinear modeling techniques developed provide means to interpret and understand the direct-strike electromagnetic data acquired on the F-106. The reasonable results obtained with the models, compared with measured responses, provide increased confidence that the models may be credibly applied to other aircraft. Author

N87-21872# National Aerospace Lab., Tokyo (Japan).
A CURVILINEAR COORDINATE THIN-LAYER NAVIER-STOKES HYBRID SCHEME FOR TRANSONIC AIRFOIL ANALYSIS
Naoki Hirose, Ken-ichi Matsuno, Koji Komatsu, and Makoto Fujita 1986 44 p In JAPANESE; ENGLISH summary
(NAL-TR-913; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

A new procedure of hybrid finite difference scheme for the two-dimensional thin-layer Navier-Stokes equations in body-fitted curvilinear coordinates is proposed. The present procedure utilizes a time and space splitting scheme which is a hybrid scheme composed of explicit and implicit schemes. MacCormack's explicit predictor-corrector scheme is applied to the flow direction. The predictor-corrector type Crank-Nicholson scheme originally developed for the boundary layer equations by Matsuno is extended to the Navier-Stokes equations and applied to the directional normal to the body surface and the boundary layer. Some numerical computations were made for a supersonic laminar boundary layer problem on a semi-infinite flat plate and for a parabolic arc airfoil problem in transonic flow. Comparison of the results with the other numerical code, NSFOIL, shows favorable agreements although some improvement in computational efficiency still remains. Author

N87-21873*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EFFECTS OF AFTERBODY BOATTAIL DESIGN AND EMPENNAGE ARRANGEMENT ON AEROPROPULSIVE CHARACTERISTICS OF A TWIN-ENGINE FIGHTER MODEL AT TRANSONIC SPEEDS
Linda S. Bangert, Laurence D. Leavitt, and David E. Reubush Jun. 1987 134 p
(NASA-TP-2704; L-16227; NAS 1.60:2704) Avail: NTIS HC A07/MF A01 CSCL 01A

The effects of empennage arrangement and afterbody boattail design of nonaxisymmetric nozzles on the aeropropulsive characteristics of a twin-engine fighter-type model have been determined in an investigation conducted in the Langley 16-Foot Transonic Tunnel. Three nonaxisymmetric and one twin axisymmetric convergent-divergent nozzle configurations were tested with three different tail arrangements: a two-tail V-shaped arrangement; a staggered, conventional three-tail arrangement; and a four-tail arrangement similar to that on the F-18. Two of the nonaxisymmetric nozzles were also vectorable. Tests were conducted at Mach numbers from 0.60 to 1.20 over an angle-of-attack range from -3 deg to 9 deg. Nozzle pressure ratio was varied from 1 (jet off) to approximately 12, depending on Mach number. Results indicate that at design nozzle pressure ratio, the medium aspect ratio nozzle (with equal boattail angles on the nozzle sidewalls and upper and lower flaps) had the lowest zero angle of attack drag of the nonaxisymmetric nozzles for all tail configurations at subsonic Mach numbers. The drag levels of the twin axisymmetric nozzles were competitive with those of the medium-aspect-ratio nozzle at subsonic Mach number. Author

N87-21874*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTATIONAL METHODS FOR UNSTEADY TRANSONIC FLOWS
John W. Edwards and J. L. Thomas Mar. 1987 31 p Presented at the AIAA 25th Aerospace Sciences Meeting, 12-15 Jan. 1987, Reno, Nev.
(NASA-TM-89106; NAS 1.15:89106; AIAA-87-0107) Avail: NTIS HC A03/MF A01 CSCL 01A

Computational methods for unsteady transonic flows are surveyed with emphasis on prediction. Computational difficulty is discussed with respect to type of unsteady flow; attached, mixed (attached/separated) and separated. Significant early computations of shock motions, aileron buzz and periodic oscillations are discussed. The maturation of computational methods towards the capability of treating complete vehicles with reasonable computational resources is noted and a survey of recent comparisons with experimental results is compiled. The importance of mixed attached and separated flow modeling for aeroelastic analysis is discussed, and recent calculations of periodic aerodynamic oscillations for an 18 percent thick circular arc airfoil are given. Author

N87-21875*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A COMPREHENSIVE ESTIMATE OF THE STATIC AERODYNAMIC FORCES AND MOMENTS OF THE 8 X 8 X 20 FT. CARGO CONTAINER
Luigi Cicolani and Gerd Kanning May 1987 84 p
(NASA-TM-89433; A-87126; NAS 1.15:89433) Avail: NTIS HC A05/MF A01 CSCL 01A

A comprehensive static aerodynamic simulation model of the 8 by 8 by 20 ft MILVAN cargo container is determined by combining the wind tunnel data from a 1972 NASA Ames Research Center study taken over the restricted domain (0 is less than or equal to phi is less than or equal to 90 degrees; 0 is less than or equal to alpha is less than or equal to 45 degrees) with extrapolation relations derived from the geometric symmetry of rectangular boxes. It is found that the aerodynamics of any attitude can be defined from the aerodynamics at an equivalent attitude in the restricted domain (0 is less than phi is less than 45 degrees; 0 is less than alpha is less than 90 degrees). However, a similar comprehensive equivalence with the domain spanned by the data is not available; in particular, about two-thirds of the domain with the absolute value of alpha is greater than 45 degrees is unrelated to the data. Nevertheless, as estimate can be defined for this region consistent with the measured or theoretical values along its boundaries and the theoretical equivalence of points within the

region. These descrepancies are assumed to be due to measurement errors. Data from independent wind tunnel studies are reviewed; these are less comprehensive than the NASA Ames Research Center but show good to fair agreement with both the theory and the estimate given here. Author

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N87-21876# Naval Postgraduate School, Monterey, Calif.
A DECISION SUPPORT SYSTEM FOR THE DIAGNOSIS OF AIRCRAFT EMERGENCIES
Olen D. Porter Dec. 1986 89 p
(Contract MIPR-ATEC-88-86)
(AD-A177394; NPS52-86-027) Avail: NTIS HC A05/MF A01 CSCL 05I

The purpose of this research is to show the feasibility of an expert system utilizing the existing sensors aboard an aircraft to aid the pilot in the diagnosis of single and compound emergencies. A passive expert planner is proposed that utilizes multiple and domain dependent knowledge bases. The system is implemented on a personal computer, using the USMC AH-1T attack helicopter as a modeling platform. An effort is made to quantify the amount of information processing necessary to adequately define emergencies. Performance of the system was also evaluated. GRA

N87-21877 Tennessee Univ., Knoxville.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF AN AIR INJECTION TYPE ANTI-ICING SYSTEM FOR AIRCRAFT Ph.D. Thesis
Abdollah Haddad Tabrizi 1986 299 p
Avail: Univ. Microfilms Order No. DA8701826

An anti-icing system was investigated in connection with the ice accretion on an aircraft engine inlet and wing leading edge. Air injection at the leading edge was used to prevent supercooled water droplets in the atmosphere from striking the surface. Through the consideration of the droplet dynamics in a two-phase flow, i.e., air-water droplets, the effectiveness and feasibility of air injection as a means of anti-icing technique was studied. An experimental investigation was also undertaken to complement the analytical study. An experimental model of a circular cylinder with injection slots was tested in a two-phase flow environment in a wind tunnel. A circular cylinder was used as an approximation of the leading edge of an engine inlet and a wing. It was shown that air injection at the leading edge-reduces the ice collection rate and that the ice reduction rate is dependent on the air injection rate and location of the injection as well as the number of slots. The ice reduction due to the surface injection was determined by weighing the ice collected on the model. Dissert. Abstr.

N87-21878*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT ACCIDENT REPORT: NASA 712, CONVAIR 990, N712NA, MARCH AIR FORCE BASE, CALIFORNIA, JULY 17, 1985, EXECUTIVE SUMMARY
Byron E. Batthauer, G. T. McCarthy, Michael Hannah, Robert J. Hogan, Frank J. Marlow, William D. Reynard, Janis H. Stoklosa, and Thomas J. Yager (National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.) Jul. 1986 9 p
(NASA-TM-87356-Vol-1; E-3110; NAS 1.15:87356-Vol-1) Avail: NTIS HC A02/MF A01 CSCL 01C

On July 17, l985, NASA 712, a Convair 990 aircraft, was destroyed by fire during an aborted takeoff at March Air Force Base in California. Material ejected from a blowout in the tires of the right main landing gear penetrated the right-wing fuel tank. The leaking fuel ignited. Fire engulfed the right wing and fuselage as the aircraft stopped its forward motion. The crew of four and the 15 scientists and technicians aboard escaped without serious injury. Author

N87-21879*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT ACCIDENT REPORT: NASA 712, CONVAIR 990, N712NA, MARCH AIR FORCE BASE, CALIFORNIA, JULY 17, 1985, FACTS AND ANALYSIS
Byron E. Batthauer, G. T. McCarthy, Michael Hannah, Robert J. Hogan, Frank J. Marlow, William D. Reynard, Janis H. Stoklosa, and Thomas J. Yager (National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.) Jul. 1986 59 p
(NASA-TM-87356-Vol-2; E-3110; NAS 1.15:87356-Vol-2) Avail: NTIS HC A04/MF A01 CSCL 01C

On July 17, l985, at 1810 P.d.t., NASA 712, a Convair 990 aircraft, was destroyed by fire at March Air Force Base, California. The fire started during the rollout after the pilot rejected the takeoff on runway 32. The rejected takeoff was initiated during the takeoff roll because of blown tires on the right landing gear. During the rollout, fragments of either the blown tires or the wheel/brake assemblies penetrated a right-wing fuel tank forward of the right main landing gear. Leaking fuel ignited while the aircraft was rolling, and fire engulfed the right wing and the fuselage after the aircraft was stopped on the runway. The 4-man flightcrew and the 15 scientists and technicians seated in the cabin evacuated the aircraft without serious injury. The fire was not extinguished by crash/rescue efforts and the aircraft was destroyed. Author

N87-22342*# National Transportation Safety Board, Washington, D. C.
COMMENTS ON THE PROBLEM OF TURBULENCE IN AVIATION
James C. McLean, Jr. *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 11-16 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

N87-22343*# Air Force Inspection and Safety Center, Norton AFB, Calif.
DOD (USAF) TURBULENCE ACCIDENTS AND INCIDENTS
Douglas Miller *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 17-25 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N87-21880# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
DESIGN DOCUMENT FOR DIFFERENTIAL GPS (GLOBAL POSITIONING SYSTEM) GROUND REFERENCE STATION PSEUDORANGE CORRECTION GENERATION ALGORITHM Interim Report, May 1985 - Jun. 1986
Dec. 1986 20 p
(Contract DTRS-57-85-X-00061)
(AD-A177190; DOT-CG-N-03-86; DOT-TSC-CG-86-2) Avail: NTIS HC A02/MF A01 CSCL 17G

The algorithms described in this report determine the differential corrections to be broadcast to users of the Global Positioning System (GPS) who require higher accuracy navigation or position

information than the 30 to 100 meters that GPS normally provides. Properly equipped marine users receiving the broadcasted corrections are expected to achieve better than 10 meters accuracy with the Differential GPS system. The Differential GPS program involves the fabrication of a differential GPS testbed, consisting of an 8-channel GPS receiver for the reference station, data processing hardware and software to generate the corrections and perform channel management and integrity functions, user receiver, and data acquisition hardware and software. The system will be tested in 1987. GRA

N87-21881# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Guidance and Control Panel.

EFFICIENT CONDUCT OF INDIVIDUAL FLIGHTS AND AIR TRAFFIC OR OPTIMUM UTILIZATION OF MODERN TECHNOLOGY FOR THE OVERALL BENEFIT OF CIVIL AND MILITARY AIRSPACE USERS

Andre Benoit, ed. Loughton, England Dec. 1986 326 p In ENGLISH and FRENCH Symposium held in Brussels, Belgium, 10-13 Jun. 1986

(AGARD-CP-410; ISBN-92-835-0403-8) Avail: NTIS HC A15/MF A01

A number of issues related to air traffic control are investigated, with particuliar attention being paid to new technologies. Attention is focused on the use of more powerful data processing technologies, the introduction of satellites for integrated navigation communications and surveillance and the potential role of automatic two-way air/ground data links. The fields covered include advanced surveillance radar, advanced landing systems, the management of air traffic, the potential and limitations of automation, including the possible applications of intelligent knowledge based systems and new onboard equipment that wil necessitate a fresh look at the relationship between air traffic control and individual aircraft. For individual titles, see N87-21882 through N87-21904.

N87-21882# Air Navigation Technical Service, Paris (France). Dept. Radiocummincation et Radioguidage.

THE SELECTION OF FUTURE CIVIL AIR NAVIGATION SYSTEMS

Olivier Carel *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 7 p (For primary document see N87-21881 15-04)

Avail: NTIS HC A15/MF A01

The International Civil Aviation Organization has established a special committee (FANS) responsible for assessing Future Air Navigation Systems. This report describes the creation of this committee and gives a detailed summary of its principle meeting, FANS-2, held in April 1985. Recent work of the committee is also discussed. Automatic dependent surveillance (ADS) and required navigation performance capability (RNPC) concepts are addressed. Finally, the rapid evaluation of aeronautic mobile communications by satellite is discussed. M.G.

N87-21883# Eurocontrol Agency, Brussels (Belgium).

AIR NAVIGATION SERVICES AND AIRCRAFT AROUND THE YEAR 2000

V. Vachiery *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 16 p (For primary document see N87-21881 15-04)

Avail: NTIS HC A15/MF A01

The Air Traffic Services (ATS) System for 2000 and beyond shall have to cope with the constantly increasing traffic demand. It shall take wholly into account the methods by which the aircraft are conducted, and, in particular the ability to adhere accurately to a predefined profile. Since 1980 a working party of the EUROCONTROL Agency has been in charge of the development of a future system concept and the formulation of a corresponding research program. The objectives, the difficulties, the main principles and the characteristics associated with the development and implementation of the future ATS concept are reviewed. The necessity for close consultation between aircraft manufacturers, avionics manufacturers, aircraft operators and the authorities responsible for air traffic management is discussed. Author

N87-21884# Stuttgart Univ. (West Germany). Inst. for Navigation.

GPS: OVERVIEW AND PRESENT STATUS

Ph. Hartl, W. Schoeller, and K.-H. Thiel *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 18 p (For primary document see N87-21881 15-04)

Avail: NTIS HC A15/MF A01

Due to various reasons the interest in the practical use of the Global Positioning System (GPS) has considerably increased during the last two years. The test phase has demonstrated its outstanding performance. With the differential method the relative accuracies achieve values that open its use even for the precision approach of aircraft landing. The development of new techniques also allows 3-dimensional attitude measurement and angular rate determination. Diverse civilian groups will use GPS in the future; in particular motor car drivers, geodesists, civil engineers etc. The present state of development and various practical applications are discussed. Author

N87-21885# Societe d'Applications Generales d'Electricite et de Mecanique, Paris (France). Dept. Aeronautique.

INERTIAL-GPS: A MARRIAGE OF REASON, AN ANALYSIS [INERTIE-GPS: UN MARIAGE DE RAISON - A L'ESSAI]

P. Lloret and B. Capit *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 23 p In FRENCH (For primary document see N87-21881 15-04)

Avail: NTIS HC A15/MF A01

The coupling of inertial navigation methods with the Global Positioning System (GPS) is examined. The characteristics of various types of inertial systems are reviewed and past attempts at inertial/radionavigation hybridizations including those with multi- and VOR-DME (VHF omnidirectional range - distance measuring equipment), Transit, OMEGA, ILS (instrument landing systems), and altitude correlation are discussed. The possible configurations for an inertial/GPS systems, given the type (classical platform and strap-down) and classes of inertial designs and the number of GPS channels utilized, are defined and performance characteristics are outlined for each. Simulation and in-flight studies of prototype systems are discussed. Signal properties and Kalman filtering are addressed. Finally, perspectives on the continuing development of inertial/GPS hybrid systems are offered. M.G.

N87-21886# Aeronautical Radio, Inc., Annapolis, Md. Engineering Dept.

COMMUNICATION, NAVIGATION AND SURVEILLANCE SERVICES FOR THE AVIATION INDUSTRY USING SATELLITE TECHNOLOGY

R. A. Pickens *In* AGARD Efficient Conduct of Individual Flights and Air Traffice or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 4 p (For primary document see N87-21881 15-04)

Avail: NTIS HC A15/MF A01

A general historical survey of Communication Navigation, and Surveillance (CNS) services for the aviation industry using satellite technology is given. Aeronautical Radio, Inc's (ARINC) air-ground communications services, which consist of VHF voice and data transfer services, and HF voice communications are discussed. ARINC's implementation of an integrated satellite system and companion integrated avionics to provide air traffic control, company operational control, navigation capability for enroute operations, and support for cooperative operations is discussed. R.J.F.

N87-21887# Eurocontrol Agency, Brussels (Belgium).
POSSIBLE CONTRIBUTIONS FROM THE SSR MODE S DATA LINK TO THE CONDUCT OF EFFICIENT AIRCRAFT OPERATIONS
M. E. Cox *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 15 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The paper entitled Data Link - The Key to Improvements in Civil Military Air Traffic Management?, presented at the Guidance and Control Panel (GCP) Symposium, Copenhagen, in October 1979, outlined a number of potential applications of a data link, then known as ADSEL/DABS, and referred to a number of feasibility studies that were being conducted in respect of these applications. Since that date the two systems (ADSEL/DABS) have led to the emergence of secondary surveillance radar (SSR) Mode S which is now being standardised for international use. Here, a brief description is given of the Mode S data link characteristics. A number of the applications proposed in 1979 are recalled and the results of studies conducted subsequently on such topics as the controller/pilot interfaces with the link and machine/machine data interchanges and their possible benefits to air traffic control (ATC) are given. Plans are discussed for more extensive data link evaluations. The initial steps that could be taken in progressing from today's situation towards a system of control employing a high level of automation are proposed. Author

N87-21888# Rome Univ. (Italy). Dept. of Electrical Engineering.
SPACE-BASED MULTIFUNCTION RADAR SYSTEMS: FUTURE TOOL FOR CIVILIAN AND MILITARY SURVEILLANCE c32
G. Galati and G. Losquadro (Selenia S.p.A., Rome, Italy) *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 9 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

Space-based surveillance systems, including primary radar (SBR) and secondary surveillance radar (SBSR) are of interest for both air traffic control and the air defence. The relevant state of the art, surveillance system architectures with special reference to the European scenario and future work are dicussed. Multifunction space-based surveillance for European applications, synthetic aperture radar for remote sensing and system options and tradeoffs are discussed. Author

N87-21889# Thomson-CSF, Meudon-la-Foret (France). SDC Div.
MONOPULSE SECONDARY RADAR: PRACTICAL REALIZATION AND ACHIEVEMENT. MODE S: THE RADAR OF TOMORROW c32
Francois Delille *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 15 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

There can be no doubt that Mode S will be part of tomorrow's Air Traffic Control (ATC) radar. Its assets in terms of air traffic surveillance and data link are noted. Fundamental characteristics are its comptatibility with existing secondary surveillance radar's (SSR), selective interrogation and monopulse reception. The monopulse SSR is a landmark in the transition towards Mode S; it contributes several major improvements, without requiring onboard transponders to be changed. Choices made in the implementation of the system are discussed, in particular as regards the antenna, transmitter, reception and processing techniques. Through these options, full Mode S compability is maintained. Practical results have turned out to be conclusive, and so the system was taken into production and already many stations are operational round the world. The Mode S extension which has to be added to the monopulse radar is also described, and it is being operated at Orly as part of an experimental development program. Author

N87-21890# Thomson-CSF, Meudon-la-Foret (France). SDC Div.
A PRACTICAL EXAMPLE OF MOVING TARGET DETECTION (MTD) PROCESSING FOR AN AIR TRAFFIC CONTROL RADAR WITH WEATHER CHANNEL c32
Christine Bruno *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 9 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

Air Traffic Control (ATC) radar processing of the Moving Target Detector (MTD) type is described. It comprises an independent processing channel called weather channel, which supplies meteorological data. The MTD processing technique is aimed at improving the detection of useful targets in the midst of clutter. The algorithms employed are detailed, as well as the performance to be expected, in particular the improvement in the radar picture presented to the operator. The processing system is made up of programmable processors, of which the architecture and other main features are described, as is the radar station remote monitoring and maintenance system. Finally, results obtained in experiments are given. Author

N87-21891# Federal Aviation Administration, Atlantic City, N.J. Technical Center.
MICROWAVE LANDING SYSTEM (MLS) AREA NAVIGATION: COMPUTED CENTERLINE EXPERIMENTS AND SYSTEM ACCURACY ANALYSIS IN AN RF ENVIRONMENT
James H. Remer and Barry R. Billmann *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 17 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

By definition of the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPS) the Time Reference Scanning Beam (TRSB) Microwave Landing System (MLS) will supplant the existing Instrument Landing System (ILS) as the recognized international standard as early as 1995. Among numerous other advantages, the MLS provides the ability to determine the aircraft's position in three dimensional space over a large coverage volume in the airport terminal area. The use of this capability to navigate and execute approaches throughout this volume of coverage results from the application of a technique known as Microwave Landing System Area Navigation (MLS RNAV). Applications of MLS RNAV can be as simple as executing approaches offset from but parallel to the MLS 0 azimuth or as complex as multi-segment and curved path approaches. MLS RNAV is particularly adaptable to helicopter operations. It allows approaches to heliports located away from the main instrumented runway. In order to assess and further develop the potential capabilities of MLS RNAV, the FAA Technical Center has undertaken the task of performing analytical studies, as well as the development of a prototype MLS RNAV system. Applications of this system to helicopter operations are particularly being emphasized. The unique feature of this work is that besides the onboard data acquisition systems, an independent source of position information was, at times, available for comparison. The source was independent position tracking in the form of laser or radar data. The work reviewed here should have immediate application in the development of MLS RNAV Terminal Area Instrument Approach Procedures (TERPS). Author

N87-21892# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Helipcopter and Military Aircraft Group.
MLS: ITS TECHNICAL FEATURES AND OPERATIONAL CAPABILITIES
R. Seifert *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 10 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

Taking into account present developments in guidance and control automation in the airplane cockpit as well as in Air Traffic Control (ATC) systems, the following aspects of the Instrument Landing System/Microwave landing system (ILS/MLS) are analyzed and presented: (1) the complexity of MLS approach procedures and function allocation to ATC and aircraft; (2) cockpit automation and presentation of MLS approach information; and (3) aspects of all weather approach and landing with military aircraft. Author

N87-21893*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED ATC: AN AIRCRAFT PERSPECTIVE
Leonard Credeur, David H. Williams, William E. Howell, and Cary R. Spitzer *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 14 p Previously announced in IAA as A86-49637 (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01 CSCL 17G

The principal operational improvements desired by commercial aircraft operators in the United States are efficient aircraft operations and delay reductions at the major terminals. Efforts underway within the Advanced Transport Operating Systems Program at the Langley Research Center to provide a technology basis for reducing delay while improving aircraft efficiency are discussed. The principal thrust is the development of time-based traffic control concepts which could be used within the framework of the upgraded National Airspace System and which would allow conventionally equipped aircraft to operate in a manner compatible with advanced aircraft. Author

N87-21894# Consiglio Nazionale delle Ricerche, Rome (Italy). Progetto Finalizzato Trasporti and Istituto di Analisis dei Sistemi ed Informatica.
STRATEGIC CONTROL TO IMPROVE EFFICIENCY OF AIR TRAFFIC MANAGEMENT
Lucio Bianco *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 10 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The strategic control concept, intended as a new management philosophy that can improve efficiency of Air Traffic Control (ATC) systems, is discussed. After having introduced a classification of the different ATC functions based on a multilevel scheme, strategic control is decomposed in a hierarchy of sub-functions. Subsequently, the on-line strategic control of flights is considered and the mathematical aspects of this problem are illustrated. Then the structure of a real time solution algorithm, proposed in a previous work, and a possible scheme of route-time profile generation are reported. Finally, computational efficiency of the proposed approach is discussed. Author

N87-21895*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TIME-BASED CONCEPT FOR TERMINAL-AREA TRAFFIC MANAGEMENT
Heinz Erzberger and Leonard Tobias *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 14 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01 CSCL 17G

An automated air-traffic-management concept that has the potential for significantly increasing the efficiency of traffic flows in high-density terminal areas is discussed. The concept's implementation depends on techniques for controlling the landing time of all aircraft entering the terminal area, both those that are equipped with on-board four-dimensional (4D) guidance systems as well as those aircraft types that are conventionally equipped. The two major ground-based elements of the system are a scheduler which assigns conflict-free landing times and a profile descent advisor. Landing time provided by the scheduler is uplinked to equipped aircraft and translated into the appropriate 4D trajectory by the-board flight-management system. The controller issues descent advisories to unequipped aircraft to help them achieve the assigned landing times. Air traffic control simulations have established that the concept provides an efficient method for controlling various mixes of 4D-equipped and unequipped, as well as low- and high-performance, aircraft. Piloted simulations of profiles flown with the aid of advisories have verified the ability to meet specified descent times with prescribed accuracy. Author

N87-21896# Federal Aviation Administration, Washington, D.C. Systems Engineering Service.
PHILOSOPHY OF APPLYING AUTOMATION TO AIR TRAFFIC CONTROL
Leland F. Page *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 3 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The objectives of the U.S. program for applying automation to air traffic control systems, progress thus far, and plans for the future are discussed. Since the time in 1958 when computers were first used to print flight strips in the United States at a small number of air traffic control (ATC) centers, it has been a continuing objective to capitalize on the rapidly evolving computer technologies to improve the ATC system. Specific objectives have been to apply computers and the associated automation functions to: improve safety of ATC operations; increase the efficiency of traffic management; and increase the productivity of ATC controllers. Author

N87-21897# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
COMPUTER ASSISTED ARRIVAL SEQUENCING AND SCHEDULING WITH THE COMPAS SYSTEM
U. Voelckers *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 11 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The Computer Oriented Metering Planning and Advisory System (COMPAS) developed at the DFVLR-Institute for Flight Guidance was tested and evaluated at the institute's air traffic simulation facility, using traffic scenarios of Frankfurt airport with up to 52 aircraft movements simultaneously. The operational objectives of the COMPAS-system are, with regard to Frankfurt airport, to achieve the best possible usage of the available but limited runway landing capacity, to avoid unnecessary delays and to apply economic approach profiles whenever possible. The planning functions which today are still carried out by human controllers will be transferred to a computer. It generates a comprehensive plan for a best overall arrival sequence and schedule. The execution of this plan, however, intentionally remains the task of the human controllers. They are provided with all data necessary to control the approaching aircraft. The systems concept, the dynamic planning algorithms as well as the operational concept for computer assistance and the man-machine interface are presented. Some preliminary results of the experiments and evaluation are reported. Author

N87-21898# Eurocontrol Agency, Brussels (Belgium).
NEXT GENERATION OF CONTROL TECHNIQUES IN ADVANCED TMA
Andre Benoit, Sip Swierstra, and Rene DeWispelaere *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 31 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

It is very likely that any future concept to be used for the safe and efficient conduct of air traffic (in terms of expedition, economy

and capacity) will exhibit two essential, closely interrelated components. Firstly, the on-line management of air traffic over a large area - from a Zone of Convergence type to a continental coverage - will generate the landing and departure times for each aircraft entering the area, while at the same time defining the essential characteristics of the relevant flight paths. Secondly, an operational control procedure will be required to conduct each individual flight accurately throughout the area, that is to say, in the case of a Zone of Convergence, from entry to touchdown, in agreement with the air traffic management directives and in line with operational practice (onboard and on the ground). The essential operational features of a control procedure suitable to meet the above constraints while ensuring a 10-second accuracy for the time of arrival as predicted initially at entry into the zone (and possibly amended subsequently), for current air carriers in present R/T or future D/L communications environments are outlined. Author

N87-21899# Smiths Industries Ltd., Bishops Cleeve (England). Engineering Dept.

EXPLOITING THE CAPABILITIES OF FLIGHT MANAGEMENT SYSTEMS IN SOLVING THE AIRPORT ARRIVAL PROBLEM

J. F. Meredith *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 10 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

Increasingly Flight Management Computers are becoming standard fit on present day passenger aircraft (737-300, 757, 767, A310, A300-600). Avionic update programs which incorporate Flight Management Computers are in hand for 747 and MD 80 and new aircraft programs A320, MD 11, 7J7, A330 and A340 are or are likely to include Flight Management Computing as standard fit. As these aircraft come to dominate the traffic entering and leaving major airports there is potentially a new level of information and of control available to the air traffic controllers whose task it is to schedule the aircraft flow into and out of the terminal area. This information flow and the consequent control actions should enable the traffic to be handled in a manner to minimise delay, thus enhancing the available traffic handling capacity of an airport. Author

N87-21900# Naval Air Development Center, Warminster, Pa.

APPLICATION OF FLIGHT PERFORMANCE ADVISORY SYSTEMS TO US NAVY AIRCRAFT

M. J. Friedman, L. J. Cowles, and R. C. Carson, Jr. *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Beneift of Civil and Military Airspace Users Dec. 1986 p 14 (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The U.S. Navy, in its Aircraft Energy Conservation Research and Development Program, is currently investigating various methods for improving the fuel efficiency of existing and future Navy aircraft. Fuel saving concepts under development include an aircraft integrated flight performance advisory system, a pre-flight mission planning program utilizing a desk type computer and an aircraft performance advisory system using an HP-41 CV hand-held calculator. The integrated flight performance advisory system for the F/A-18, the A-7E, and the S-3 are described in detail by reviewing the displayed outputs to the pilots and describing the required inputs and their sources. Features of each aircraft system are described in accordance with the development status of the program. The preflight mission planning program utilizing an HP-9845 desktop computer is described for the P-3C aircraft. The approach to weather, takeoff and cruise are described by specifying the input and output data. Sample displays are also shown. The hand-held HP-41 CV calculator utilized for flight performance predictions is described for the P-3C. All the calculator functions are described for the takeoff and cruise flight modes of this aircraft. The operational status of these three programs and plans for other Navy aircraft are also specified. Author

N87-21901# Technische Univ., Brunswick (West Germany). Inst. for Guidance and Control.

DESIGN CRITERIA FOR MULTI-LOOP FLIGHT CONTROL SYSTEMS **c08**

G. Schaenzer *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 12 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The problems of design criteria and architecture of multiloop flight control systems for a realized system to achieve precise flight path guidance, safe and economic control of the aerodynamic flow (airspeed, angle of attack and lift coefficient control) and passenger comfort are discussed. Joint root locus and quality criteria design are presented. The structure of the presented multiloop flight control system consists of nonlinear open loop control for flight performance and flight management; superposed quasilinear state vector feedback; and six control surfaces (aileron, rudder, elevator, trim, throttle, direct lift/drag control). Author

N87-21902# Royal Aircraft Establishment, Bedford (England). Flight Systems Div.

SOME EXPERIENCES IN INTEGRATING AVIONIC SYSTEMS ON THE CIVIL FLIGHT DECK **c06**

P. England, R. Harlow, and N. Cooke *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 17 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

Some of the work carried out in the Civil Avionics Research program at the Royal Aircraft Establishment, Bedford is described. After a discussion of some of the factors that are leading to a future Air Traffic Management system, the activities in navigation, flight management, displays and novel human input techniques are reviewed. The progress made and some of the lessons learned are also described. A view of how a future air traffic management system might operate is given. Author

N87-21903# Royal Signals and Radar Establishment, Malvern (England).

SEMI-AUTOMATIC CROSS-CHECKING BETWEEN DIFFERENT COPIES OF THE SAME FLIGHT PLAN

S. Ratcliffe *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 7 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

A flight-plan usually exists in several different forms in the aircraft flight management system: as hard copy on the flight-deck, in one or more Air Traffic Control/(ATC) data processors, and distributed over flight-progress strips (or their electronic equivalents) in one or more control centers. Any discrepancies between various versions of the plan are potentially hazardous. Given that the flight plan is already stored, for one reason or another, in at least one computer, it is proposed that each computer should also be used to generate a check word which can easily and rapidly be compared with that stored as hard-copy or in some other machine. The check word might consist of four alpha characters which can easily be remembered and passed by voice. Possible algorithms for generating check-words are discussed. The results of some laboratory trials of a prototype system are given. Author

N87-21904# Civil Aviation Authority, London (England).

THE APPLICATION OF INTELLIGENT KNOWLEDGE BASED SYSTEMS TO AIR TRAFFIC CONTROL

W. S. Nicol, G. C. Dean, A. Jackson, and W. A. Stretton (Royal Signals and Radar Establishment, Malvern, England) *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 9 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

The need to explore the approach of Intelligent Knowledge Based Systems (IKBS) towards meeting the pressures for change in future air traffic control systems is discussed. The discussion includes the role of automation in air traffic control (ATC) and the suitability of IKBS within a shared approach between controller and machine. Areas selected to provide practical experience of IKBS applied to ATC include air traffic flow management and conflict resolution and training. Finally, guideline concepts for the introduction of a new technology to ATC are outlined. Author

N87-21905# Massachusetts Inst. of Tech., Lexington. Lexington Lab.

TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (TCAS) SURVEILLANCE PERFORMANCE IN HELICOPTERS

William H. Harman, III, Jerry D. Welch, and M. Loren Wood, Jr. 8 May 1987 106 p

(Contract F19628-85-C-0002)

(DOT/FAA/PM-85/29; Proj-Rept-ATC-135) Avail: NTIS HC A06/MF A01

Subsequent to the development of the Traffic Alert and Collision Avoidance System (TCAS) equipment for fixed-wing aircraft, a follow-on effort addressed the suitability of such equipment for use in helicopters. This program focused on those differences between helicopters and fixed-wing aircraft that might be expected to affect TCAS performance: the large rotor, the relatively irregular shape of the fuselage, the low speeds and high turn rates typical of helicopter flights, and the over-water and low-altitude conditions typical of helicopter operations. A Bell Long Range helicopter was acquired and equipped with experimental TCAS equipment with full data recording capability. Flight experiments were conducted to assess air-to-air surveillance performance under challenging conditions. Other flights involved guest pilots for subjective evaluations of the TCAS performance. It was concluded that the air-to-air surveillance techniques that were originally developed for use in large jet airliners will also perform satisfactorily in helicopters. It was also concluded that, because of the flight characteristics of helicopters, the pilot display should consist of traffic advisories alone, without resolution advisories. Author

N87-21906# National Aerospace Lab., Tokyo (Japan).

DEVELOPMENT AND FLIGHT VERIFICATION OF AIRBORNE GLIDESLOPE COMPUTATION/GUST DETECTION SYSTEM

Takatsugu Ono, Masaki Komoda, Nagakatsu Kawahata, and Yukichi Tsukano 1986 26 p In JAPANESE; ENGLISH summary

(NAL-TR-908; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

An airborne Glideslope Computation/Gust Detection System was developed for supporting flight tests of the National Aerospace Laboratory's Variable Stability and Response Airplane (VSRA). The system includes a set of Kalman filters to estimate position and inertial velocity and utilizes signals from the pressure altimeter, and accelerometers and gyros. Glideslope and localizer deviations from a preselected nominal flight path having an arbitrarily assigned glideslope angle, are computed and transmitted to ADI and HSI instead of the standard ILS signals. Gust components as differences of inertial and air speeds are also estimated. Based upon flight test data, estimated horizontal inertial speed is compared with that obtained from Doppler radar, and validity and accuracy of gust estimation are verified by state reconstruction techniques. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N87-21907# Boeing Military Airplane Development, Seattle, Wash.

FAULT TOLERANT ELECTRICAL POWER SYSTEM. PHASE 2: ANALYSIS AND PRELIMINARY DESIGN Interim Report, 1 Jul. 1985 - 31 Mar. 1986

Mark W. Dige, Patrick J. Leong, and David L. Sommer Dec. 1986 188 p

(Contract F33615-85-C-2504)

(AD-A177278; D180-28576-3; AFWAL-TR-86-2084-2) Avail: NTIS HC A09/MF A01 CSCL 10B

The primary purpose of the program is to develop an electrical power generation and distribution system that can supply electrical power to the various critical systems on the aircraft with a reliability and power quality level commensurate with the requirements of the loads. Phase 2 consisted of 4 tasks: Task 1-FTEPS Demonstrator Basic Requirements, Task 2-Analysis, Task 3-FTEPS Demonstrator Conceptual Design, and Task 4-FTEPS Demonstrator Preliminary Design. In Task 1, the basic fault and reliability requirements of the system were developed and a load profile was established for the baseline aircraft. Task 2 activities included development of specific system requirements and reliability analysis of power delivered to the main power buses of different architectures. A data bus analysis was performed on an integrated single data bus and an integrated hierarchical data bus. The hierarchical data bus was selected for the FTEPS. In Task 3, conceptual designs were developed for a 3 generator configuration and a 4 generator configuration with the 4 generator configuration being selected for further development in Task 4, Preliminary Design. Preliminary designs were developed for the power generator system, the distribution system, the data bus control system, the integrated load simulator and a laboratory support system. GRA

N87-21908*# National Aeronautics and Space Administration. Dryden (Hugh L.) Flight Research Center, Edwards, Calif.

FLIGHT TEST TECHNIQUES FOR THE X-29A AIRCRAFT

John W. Hicks, James M. Cooper, Jr., and Walter J. Sefic Feb 1987 14 p Presented at the AIAA 25th Aerospace Sciences Meeting, Reno, Nev., 12-15 Jan. 1987 Previously announced in IAA as A87-22403

(NASA-TM-88289; H-1401; NAS 1.15:88289; AIAA-87-0082) Avail: NTIS HC A02/MF A01 CSCL 01C

The X-29A advanced technology demonstrator is a single-seat, single-engine aircraft with a forward-swept wing. The aircraft incorporates many advanced technologies being considered for this country's next generation of aircraft. This unusual aircraft configuration, which had never been flown before, required a precise approach to flight envelope expansion. This paper describes the real-time analysis methods and flight test techniques used during the envelope expansion of the x-29A aircraft, including new and innovative approaches. Author

N87-21909# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.

HIGH-SPEED-PERFORMANCE ANALYSIS. NOMINAL AND OPTIMAL BOOST CLIMB PERFORMANCE ANALYSIS Final Report, Jul. 1985 - Mar. 1986

L. E. Miller Jan. 1987 97 p

(AD-A177699; AFWAL-TR-86-3075) Avail: NTIS HC A05/MF A01 CSCL 20D

Nominal and optimal boost climb trajectories were developed for an air-launched vehicle. The agreement between approximate nominal and exact numerical solutions was quite good. Three payoffs were addressed for the optimal trajectories; maximum

speeds at burnout or apogee, minimum fuel to apogee, and minimum time to apogee. The last two are equivalent since the fuel-burning rate was constant. Thrust vectoring was considered for one problem, but the difference relative to zero thrust vectoring was negligible. The remaining problems only considered zero thrust vectoring. In general, the optimal angle-of-attack decreased with increasing time. The change was greater for the minimum time solution. For this case, a fast pitch-up occurred initially and then the angle-of-attack rapidly decreased to the angle-of-attack for -C sub LMAX. They gave the fastest pitch over to apogee. The minimum time solution may reach apogee before burn-out. This never occurs for the maximum speed case; the terminal condition is reached at or after burn-out. Author (GRA)

N87-21910# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

PROTOTYPE KNOWLEDGE ACQUISITION AND REPRESENTATION EDITOR FOR THE F-16 FLIGHT DOMAIN M.S. Thesis

Darleen A. Sobota Dec. 1986 153 p

(AD-A177717; AFIT/GCE/ENG/86D-4) Avail: NTIS HC A08/MF A01 CSCL 09B

Current research in the study of intent inferencing for the fighter aircraft flight domain is hampered by the problem, 'How should knowledge required about the flight domain be acquired and represented?' Without automated tools for acquiring and representing knowledge, large expert system development will continue to be hindered. The purpose of this thesis was the initial design and construction of a prototype editor to assist in the acquisition and representation of script-based knowledge in the context of the F-16C flight domain. The editor was responsible for: maintaining the internal consistency of the knowledge in the context of the F-16C flight domain. The editor was responsible for: maintaining the internal consistency of the knowledge base when knowledge was added, updated, or deleted; preventing syntax errors in formatting by providing cascading menus for domain specific knowledge entry, while leaving the frame-based formatting details to the editor tool, and; preventing spelling errors among already existing (created) knowledge items by providing pilot selectable pop-up menus reflecting the current state of valid choices in the knowledge base for a particular item. Other potential benefits of an automated knowledge acquisition and representation editor are discussed. GRA

N87-21911# Air War Coll., Maxwell AFB, Ala.

AUGMENTOR WING POWERED LIFT TECHNOLOGY: AFFORDABLE ALTERNATIVES TO ENHANCE TACTICAL AIRLIFT CAPABILITY

John E. McGee May 1986 135 p

(AD-A177750; AD-E751201; AU-AWC-86-143) Avail: NTIS HC A07/MF A01 CSCL 01C

Remarks on the status and capabilities of Augmentor Wing (AW) powered lift technology introduce a discussion of potential Air Force needs satisfaction in a variety of affordable aircraft applications. A description of technology capabilities and cost comparison examples complete the background for the author's view on current and future air force inter- and intra-theater tactical airlift operational and program benefits from this technology. Competing technologies and AW applications on Short Take-Off Vertical Land (STOVL) tactical and strategic airlifters and the adaptation of Ejector Lift/Vertical Thrust (EL/VT) technology to an advanced pilot trainer aircraft and a Supersonic Short Take-Off Vertical Land (SSTOVL) fighter, as in the Advanced Tactical Fighter (ATF) and Advanced/Short Take Off Vertical Land (A/STOVL) aircraft are discussed. International development of a joint technology demonstrator and a next generation tactical airlifter to meet United States, Canadian, United Kingdom, West German, French, Australian and other allied requirements is suggested. GRA

N87-21912# Air War Coll., Maxwell AFB, Ala.

THE BEST INVESTMENT FOR THE AIR SUPERIORITY FIGHTER OF THE YEAR 2000: THE AIRCRAFT, ITS WEAPON SYSTEM OR ITS ARMAMENT?

Jean-Georges Brevot May 1986 47 p

(AD-A177767; AU-AWC-86-030) Avail: NTIS HC A03/MF A01 CSCL 01C

Assuming that the cost rising problem and the budget constraints will compel the planners to important trade-offs in the air superiority fighter programs for the year 2000, the author tries to determine which research and development investments will be the most productive for the mission effectiveness. After studying the threat, growing both in quantity and quality, he analyses the characteristics of modern air combat and the current technology trends. Looking forward to the future, he draws the new requirements and then advocates for the good priorities in the investments to come. GRA

N87-21913# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.

IDENTIFICATION OF DYNAMIC SYSTEMS - APPLICATIONS TO AIRCRAFT. PART 1: THE OUTPUT ERROR APPROACH

R. E. Maine and K. W. Iliff Dec. 1986 187 p

(AGARD-AG-300-Vol-3-Pt-1; ISBN-92-835-1540-4) Copyright Avail: NTIS HC A09/MF A01

This document examines the practical application of parameter estimation methodology to the problem of estimating aircraft stability and control derivatives from flight test data. The primary purpose of the document is to present a comprehensive and unified picture of the entire parameter estimation process and its integration into the flight test program. The document concentrates on the output-error method to provide a focus for detailed examination and to allow us to give specific examples of situations that have arrisen in our experience. The document first derives the aircraft equations of motion in a form suitable for application to estimation of stability and control derivatives. It then discusses the issues that arise in adapting the equations to the limitations of analysis programs, using a specific program for an example. The document then addresses the roles and issues relating to mass distribution data, preflight predictions, maneuver design, flight scheduling, instrumentation sensors, data acquisition systems, and data processing. Finally, the document discusses evaluation and use of the analysis results. Author

N87-21914# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Research and New Programs Dept.

WARHEAD EFFECTS ON AIRBORNE TARGETS

Manfred Held 1985 7 p Repr. from Interavia Rev. (Geneva, Switzerland), no. 3, 1986

(MBB-UA-912/85; ETN-87-99920) Avail: NTIS HC A02/MF A01

The effects of direct hits, blast, fragments, and cumulative damage from warheads on airborne targets are reviewed. Effect modeling is discussed. ESA

N87-21915*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS OF THE FREE-TIP ROTOR WIND-TUNNEL TEST RESULTS

Robert H. Stroub May 1985 70 p

(NASA-TM-86751; Rept-85236; NAS 1.15:86751) Avail: NTIS HC A04/MF A01 CSCL 01C

The results from a wind tunnel test of a small scale free-tip rotor are analyzed. The free-tip rotor has blade tips that are free to weathervane into the tip's relative wind, thus producing a more uniform lift around the azimuth. The free-tip assembly, which includes the controller, functioned flawlessly throughout the test. In a test of the free-tip's response after passing through a vertical air jet, the tip pitched freely and in a controlled manner. Analysis of the tip's response characteristics showed the free-tip system's damped natural frequency to be 5.2 per rev. Tip pitch angle responses to the local airstream are presented for an advance-ratio

range of 0.1 to 0.397 and for a solidity weighted rotor lift coefficient range of 0.038 to 0.092. Harmonic analysis of the responses showed a dominance by the first harmonic. As a result of the tip being free, forward flight power requirements were reduced by 8% or more. More power reduction was recorded for high thrust conditions. In addition to the power reduction, flatwise blade bending moments were reduced by as much as 30% at the inboard blade stations. Author

N87-21916# National Aerospace Lab., Tokyo (Japan).
TRANSONIC AIRFOIL DESIGN BASED ON THE NAVIER-STOKES EQUATIONS TO ATTAIN ARBITRARILY SPECIFIED PRESSURE DISTRIBUTION: AN ITERATIVE PROCEDURE
Naoki Hirose, Susumu Takanashi, and Nobuhiro Kawai Mar. 1986 18 p
(NAL-TR-901T; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

An iterative procedure for transonic airfoil design based on the Navier-Stokes equations to attain arbitrarily specified pressure distributions is proposed. A transonic integral equation for the inverse problem for the correction term between the basic pressure distribution and the specified pressure distribution is formulated and is combined with a time-averaged Navier-Stokes airfoil analysis code. Shock wave and viscous effects including weak separation are properly evaluated in the analysis mode and therefore are effectively incorporated in the design procedure. Numerical results for a shockless pressure distribution and a supercritical pressure distribution are presented. A small number of iterative steps yield almost satisfactory airfoil geometry from a practical point of view. The method is also applied to low speed airfoil designs and the results are shown. Author

N87-21917*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FUEL PENALTIES AND TIME FLEXIBILITY OF 4D FLIGHT PROFILES UNDER MISMODELED WIND CONDITIONS
David H. Williams Mar. 1987 28 p
(NASA-TM-89128; NAS 1.15:89128) Avail: NTIS HC A03/MF A01 CSCL 01C

A parametric sensitivity study was conducted to evaluate time flexibility and fuel penalties associated with 4D operations in the presence of mismodeled wind. The final cruise and descent segments of a flight in an advanced time-metered air traffic control environment were considered. Optimal performance of a B-737-100 airplane in known, constant winds was determined. Performance in mismodeled wind was obtained by tracking no-wind reference profiles in the presence of actual winds. The results of the analysis are presented in terms of loss of time flexibility and fuel penalties compared to the optimum performance in modeled winds.
Author

N87-22344*# Douglas Aircraft Co., Inc., Long Beach, Calif.
NEW GENERATION AIRCRAFT DESIGN PROBLEMS RELATIVE TO TURBULENCE STABILITY, AEROELASTIC LOADS AND GUST ALLEVIATION
Richard M. Heimbaugh *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 27-45 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N87-21918# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
EVALUATION OF THE SAFE FLIGHT INSTRUMENT CORPORATION STALL WARNING SYSTEM FOR THE OV/1D AIRCRAFT Final Report, 26 Oct. - 26 Nov. 1985
Joseph C. Miess, Robert D. Robbins, and Jeffrey L. Linehan Feb. 1986 42 p
(AD-A177364; USAAEFA-85-16) Avail: NTIS HC A03/MF A01 CSCL 01D

An evaluation of the Safe Flight Instrument Corporation (SFIC) stall warning system for the OV-1D aircraft was conducted by the US Army Aviation Engineering Flight Activity (AEFA) to determine variation in stall warning margins from those observed in USAAEFA Project No. 84-13 resulting from changes in the SFIC stall warning system and aircraft configuration. Changes in aircraft configuration included incorporation of wing tip radar jammer antenna fairings (AN/ALQ-136(V)2), and modification of the right wing deice boot to accept the stall warning system lift transducer. Changes in the SFIC stall warning system included addition of a pendulous accelerometer and software changes to the lift computer, and replacement of the 700 Hertz (Hz) audio tone generator with a 400 Hz audio tone generator. The test aircraft was equipped with the Louvered Scarfed Shroud Suppressor (LSSS) and was flown with and without external aircraft mission/survivability equipment installed. The evaluation was conducted at Edwards Air Force Base, California between 26 October and 26 November 1985 and consisted of 23 flights totaling 40.5 flight hours (32.5 productive flight hours). The evaluation consisted of two phases during which dual and single-engine unaccelerated stalls, dual-engine accelerated stalls and evasive maneuvers were performed. GRA

N87-21919# Air War Coll., Maxwell AFB, Ala.
F-16 DIGITAL TERRAIN SYSTEM: CONCEPT OF OPERATIONS AND SUPPORT
Paull C. Burnett, Manuel W. Garrido, Ronnie K. Morrow, and Barton C. Tucker Mar. 1986 70 p
(AD-A177737; AD-E751201; AU-AWC-86-215) Avail: NTIS HC A04/MF A01 CSCL 01D

Presented is a concept of operations and support for an F-16 equipped with a digital terrain system (DTS) using stored digital, three-dimensional terrain data. By overlaying the terrain data with route information threats, and cultural features, it is possible to display to the pilot all required map information. Additional DTS functions include automated mission planning, inflight retargeting, autonomous navigation, and ground proximity warning. These capabilities will reduce pilot workload by providing a single-glance tactical situation overview and allow the pilot to know exactly where he is at all times in flight to better avoid threats and make maximum use of terrain masking. In an operational environment with increasingly sophisticated threats, the DTS offers the potential to increase survivability and lethality by enhancing pilot situational awareness and reducing pilot workload. A significant part of this workload reduction will be acheived by automating mission planning on the ground to include preprogramming many of the pilot selectable features such as map scale, changes from plan view to perspective view, changes in cultural features to be shown, and sensor cueing against specific targets (sensor prepointing). Mission phases presented include mission planning; ground operations; low-level ingress and egress; air-to-surface operations both conventional and nuclear; air-to-air operations; and routine flight operations. GRA

N87-21920# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Flight Mechanics Panel.
MICROPROCESSOR APPLICATIONS IN AIRBORNE FLIGHT TEST INSTRUMENTATION

M. J. Prickett Feb. 1987 66 p
(AGARD-AG-160-Vol-18; ISBN-92-835-1542-0) Copyright Avail: NTIS HC A04/MF A01

This volume in the AGARD Flight Tests Instrumentation Series addresses flight test engineers and flight test instrumentation engineers interested in the design of microprocessors into new airborne flight test equipment. It describes general microprocessor based, system design principles and architectures suitable for flight test and flight test instrumentation applications. In preparing this volume the author has met with several engineers actively participating in aircraft and electronic flight testing at various organizations. Each of these organizations has developed microprocessor based instrumentation to solve their unique requirements and these are described in this text as case studies of current microprocessor applications. Author

N87-21921*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE EFFECTS OF DISPLAY AND AUTOPILOT FUNCTIONS ON PILOT WORKLOAD FOR SINGLE PILOT INSTRUMENT FLIGHT RULE (SPIFR) OPERATIONS Final Report
Roger H. Hoh, James C. Smith (Systems Technology, Inc., Hawthorne, Calif.), and David A. Hinton Washington NASA 1987 107 p
(Contract NAS1-17928)
(NASA-CR-4073; NAS 1.26:4073) Avail: NTIS HC A06/MF A01 CSCL 01D

An analytical and experimental research program was conducted to develop criteria for pilot interaction with advanced controls and displays in single pilot instrument flight rules (SPIFR) operations. The analytic phase reviewed fundamental considerations for pilot workload taking into account existing data, and using that data to develop a divided attention SPIFR pilot workload model. The pilot model was utilized to interpret the two experimental phases. The first experimental phase was a flight test program that evaluated pilot workload in the presence of current and near-term displays and autopilot functions. The second experiment was conducted on a King Air simulator, investigating the effects of co-pilot functions in the presence of very high SPIFR workload. The results indicate that the simplest displays tested were marginal for SPIFR operations. A moving map display aided the most in mental orientation, but had inherent deficiencies as a stand alone replacement for an HSI. Autopilot functions were highly effective for reducing pilot workload. The simulator tests showed that extremely high workload situations can be adequately handled when co-pilot functions are provided. Author

N87-21902# Royal Aircraft Establishment, Bedford (England). Flight Systems Div.
SOME EXPERIENCES IN INTEGRATING AVIONIC SYSTEMS ON THE CIVIL FLIGHT DECK
P. England, R. Harlow, and N. Cooke *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 17 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N87-21922# Naval Postgraduate School, Monterey, Calif.
THE EFFECTS OF METALLIZED FUEL COMPOSITION ON THE COMBUSTION CHARACTERISTICS OF SOLID FUEL RAMJETS (SFRJ) M.S. Thesis
Adonis Karadimitris Dec. 1986 79 p
(AD-A176744) Avail: NTIS HC A05/MF A01 CSCL 21B

Experiments investigated the effects of metallized fuel composition on the combustion characteristics of solid fuel ramjets (SFRJ). Metallized fuels were burned in a two dimensional SFRJ motor under conditions similar to actual flight conditions proposed for solid fuel ramjets. Pressure, air inlet temperature and flowrate measurements were taken using an automatic data acquisition system. High speed motion pictures were taken of the interior or the combustor during the burning of the solid fuel through two viewing windows located in the recirculation zone and just prior to the aft mixing chamber where the boundary layer was more fully developed. Tests were conducted at mass fluxes of 0.2 and 0.5 lbm sq in. sec, with pressures ranging from 57 to 200 psia and with a nominal inlet air temperature of 1100 R. Most fuel surfaces had a characteristic shedding of small, unignited flakes. The flakes are thought to be binder material, and were more prevalent at lower pressures. Occasional shedding of large surface layers was observed, especially during motor shutdown. Metallic surface agglomerations appeared to interact strongly with these irregular surface layers. Large magnesium particles exhibited the expected bright ignition characteristics. Boron particles were not observed, apparently because they were smaller than the resolution limits of the motion pictures. GRA

N87-21923# Nu-Tech Industries, Inc., Dayton, Ohio.
OPTIMIZATION OF MOTOR/GEAR DRIVE SYSTEM FOR ELECTRIC RPV Final Report, Jan. - Sep. 1986
Milton Issacson Oct. 1986 14 p
(Contract F33615-86-C-2608)
(AD-A177492; AFWAL-TR-87-2013) Avail: NTIS HC A02/MF A01 CSCL 10B

The goal of Phase I was to prove the feasibility of using a high speed brushless dc motor for propulsion in an RPV application. The electric propulsion system would include a brushless dc motor, electronic controller, and gear reducer that is optimally sized for the cruise condition of an RPV. Performance tests were to be conducted to measure developed power, while driving a propeller loaded at the cruise condition, and to test for the adequacy of heat rejection from the motor in the RPV configuration. The system was to be packaged for minimum size and weight. A complete electric propulsion system consisting of a brushless dc motor, controller, gearbox, and propeller was configured and bench tested. Heat rejection tests were also performed on the brushless dc motor in the RPV configuration. The final system of motor, controller and heat rejection hardware was then packaged for minimum size and weight. In the bench power tests output from the motor was measured to be 5 hp. The heat rejection tests showed that adequate cooling should be attainable through further improvements in a total cooling system. GRA

N87-21924# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.
A POST-STALL COMPRESSION SYSTEM MODELING TECHNIQUE Final Report, 1 Oct. 1984 - 30 Sep. 1986
M. W. Davis, Jr. Feb. 1987 98 p Prepared in cooperation with AEDC, Arnold Air Force Station, Tenn.
(AD-A177610; AEDC-TR-86-34) Avail: NTIS HC A05/MF A01 CSCL 21E

This report presents a one dimensional, stage by stage compression system modeling technique capable of exhibiting post stall behavior such as surge and rotating stall. Included is a brief overview of previous efforts by others, their major contributions and how the present effort enhances and extends these efforts. THe modeling techniques, governing equations, numerical simulation, and stability criteria are all discussed. The model is validated by comparing it with a multitude of experimental test results from low-speed and high-speed compressor rigs and engine test results. The model provides an analysis tool for analyzing compression system and individual stage behavior during surge and rotating stall. Because the modeling technique is based upon stage characteristics, stage modifications can be analyzed for their affect on recoverability. GRA

N87-21925# Universal Energy Systems, Inc., Dayton, Ohio.
EVALUATION AND ANALYSIS OF GAS TURBINE INTERNAL FLOW RESTRICTORS Final Report, Aug. 1985 - Apr. 1986
Glenn F. Holle Aug. 1986 156 p
(Contract F33615-85-C-2575)
(AD-A177836; AFWAL-TR-86-2050) Avail: NTIS HC A08/MF A01 CSCL 20D

A comprehensive review of the literature concerning pressure loss calculations for flow through turns and bends, dividing and combining branches, sudden area changes, and orifices was conducted. An evaluation of the proposed analytical procedures was made on the bases of applicability to gas turbine internal flow systems, accuracy of the flow characteristic predictions, and the complexity of the restriction modeling. A standardized loss analysis procedure for each restriction type was selected from the reliable pressure loss models available in the literature. GRA

N87-21926 California Univ., Los Angeles.
STRUCTURAL DYNAMIC MODELING OF ADVANCED COMPOSITE PROPELLERS BY THE FINITE ELEMENT METHOD Ph.D. Thesis
John Benedict Kosmatka 1986 332 p
Avail: Univ. Microfilms Order No. DA8702598

An analytical model is presented for determining the free vibration characteristics of conventional and advanced propellers composed of generally anisotropic materials (i.e., composite construction). It is assumed that the propeller is discretized into a series of straight beams (beam-type finite element), where the elastic axis of each beam element is aligned with the line of shear centers of the propeller. Blades of arbitrary shape and definition can be analyzed, since this line of shear centers is represented by a general space curve. Results include: (1) verification studies that were done with known analytical and experimental solutions, and (2) the determination of the structural dynamic characteristics of a conventional propeller and an advanced propeller. Results from these studies show very good agreement with experimental data. A model, which is used to determine the shear center, structural constants, and shear stress distribution of an arbitrary shaped cross section composed of multiple generally anisotropic materials is also presented.
Dissert. Abstr.

N87-21927# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Specialists.
TRANSONIC AND SUPERSONIC PHENOMENA IN TURBOMACHINES
Loughton, England Mar. 1987 374 p In ENGLISH and FRENCH Meeting held in Munich, West Germany, 10-12 Sep. 1986
(AGARD-CP-401; ISBN-92-835-0413-5) Copyright Avail: NTIS HC A16/MF A01

The Specialists' Meeting was arranged in the following sessions: Experimental Data on Shock Structures; Shock Induced Losses Including Shock Boundary Layer Interaction; Computational Results; and Blade Design Methods. In order to maintain high efficiency and reliability of advanced engines with high speed in compressors and turbines, a deep understanding of the influence of transonic and supersonic phenomena is essential. The meeting was aimed at providing a contribution to this goal. For individual titles, see N87-21928 through N87-21951.

N87-21928# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FUNDAMENTAL STUDIES ON SHOCK-WAVE/BOUNDARY-LAYER INTERACTIONS IN A 3D CHANNEL
R. Benay, T. Pot, and J. Delery *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH; ENGLISH summary Original language document was announced in IAA as A87-21068 (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

Detailed experimental data on shock-wave/boundary-layer interaction in 3-D flows is still relatively scarce. This fact brought ONERA to undertake experiments in view of producing as complete a literature as possible on a three-dimensional transonic channel flow with shock. The test set-up is a channel with a 100 x 120 mm inlet section. The lower wall of the channel is humped while the other three faces are flat. In operation, a continuous supersonic flow is started and shock recompressions formed on the descending part of the hump. The flow in the interaction region was carefully analyzed by using, in particular, a three-color LDV system. The tests brought out a strongly three-dimensional flow structured very differently from the one observed in 2-D channel flows. It was revealed that in the presence of the strong adverse pressure gradient of the shock, a 3-D boundary layer tends to thicken less than a 2-D boundary layer, since the flow can reorganize in a much more complex fashion in the three directions of space. The precise data obtained were analyzed to arrive at a better understanding of the phenomena from a physical point of view, and also constitute a data base for validating the calculation models being developed. Author

N87-21929*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHOCK STRUCTURE MEASURED IN A TRANSONIC FAN USING LASER ANEMOMETRY
Jerry R. Wood, Anthony J. Strazisar, and P. Susan Simonyi (Sverdrup Technology, Inc., Middleburg Heights, Ohio.) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 14 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01 CSCL 21E

Shock structure measurements acquired in a low aspect ratio transonic fan rotor are presented and analyzed. The rotor aspect ratio is 1.56 and the design tip relative Mach number is 1.38. The rotor flowfield was surveyed at near maximum efficiency and near stall operating conditions. Intra-blade velocity measurements acquired with a laser fringe anemometer on blade-to-blade planes in the supersonic region from 10 to 60% span are presented. The three-dimensional shock surface determined from the velocity measurments is used to determine the shock surface normal Mach number in order to properly calculate the ideal shock jump conditions. The ideal jump conditions are calculated based upon the Mach numbers measured on a surface of revolution and based upon the normal Mach number to indicate the importance of accounting for shock three dimensionality in turbomachinery design. Comparison of the shock locations with those predicted by a 3-D Euler code showed very good agreement and indicated the usefulness of integrating computational and experimental work to enhance the understanding of the flow physics occurring in transonic turbomachinery passages. Author

N87-21930# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Dept. of Engineering Sciences.
WAKE AND SHOCK INTERACTIONS IN A TRANSONIC TURBINE STAGE
D. L. Schultz, A. B. Johnson, D. A. Ashworth, M. J. Rigby, and J. E. LaGraff (Syracuse Univ., N. Y.) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 16 p (For primary document see N87-21927 15-07)
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The strong trailing-edge shock waves from the nozzle guide vanes of transonic turbine stages can give rise to interactions with the downstream rotor which are significantly more severe than is the case with lower pressure ratio stages. It is therefore important to study such effects in detail both from the point of view of stage power output and more importantly from that of heat transfer rates. Transonic rotor profile was made in a static cascade in which the effect of shock wave interaction is simulated by means of an array of bars rotating at the correct speed and spacing upstream of the stationary rotor blades. Detailed heat transfer rate measurements made with rapid response gauges enable the wake and shock phenomena to be separated. Author

N87-21931# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Entwurfsaerodynamik.

THE BOUNDARY LAYER BEHAVIOUR OF HIGHLY LOADED COMPRESSOR CASCADE AT TRANSONIC FLOW CONDITIONS

H. Hoheisel and N. J. Seyb (Rolls-Royce Ltd., Bristol, England) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 17 p (For primary document see N87-21927 15-07)

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The design of efficient blade profiles for gas turbine compressors can no longer be effectively carried out through the use of correlations of 2D-cascade data. For the description of the real flow field three dimensional effects have to be taken into account. Modern theoretical calculation methods which involve the determination of blade profile pressure distribution and the associated boundary layer parameters, are now becoming accepted practice. However before the engine designer can have confidence in these methods the predicted performance must be demonstrated to be in good agreement with experimental data. An accurate set of experimental measurements of blade profile pressure distributions and boundary layer parameters are presented under quasi-3D-flow conditions and these are compared with the predicted performance for a high deflection transonic compressor cascade. It is shown that for conditions near minimum loss incidence the agreement between measure and predicted values is achieved to an adequate engineering standard and that the two most important aspects, choking flow and boundary layer separation are well predicted. Also the data presented could be used to further update and improve the current prediction methods. Author

N87-21932*# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.

VORTEX SHEDDING IN COMPRESSOR BLADE WAKES

A. H. Epstein, J. B. Gertz, P. R. Owen, and M. B. Giles *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 13 p Sponsored by NASA. Lewis Research Center and AFOSR (For primary document see N87-21927 15-07)

Copyright Avail: NTIS HC A16/MF A01 CSCL 21E

The wakes of highly loaded axial compressor blades were often considered to be turbulent, unstructured flows. Recent work has suggested that the blade wakes are in fact dominated by a vortex street-like structure. The work on the wake structure at MIT is reviewed, the results of a viscous numerical simulation are presented, the blade wake vortices are compared to those shed from a cylinder, and the implications of the wake structure on compressor performance are discussed. In particular, a two-dimensional, time accurate, viscous calculation shows both a periodic wake structure and time variations in the passage shock strength. The numerical calculations are compared to laser anemometer and high frequency response probe data. The effect of the wake structure on the entropy production and apparent adiabatic efficiency of the compressor rotor is discussed. Author

N87-21933# Cambridge Univ. (England). Dept. of Engineering.

EXPERIMENTAL OBSERVATIONS ON AN UNSTEADY, NORMAL SHOCK/BOUNDARY LAYER INTERACTION **c34**

In AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 14 p (For primary document see N87-21927 15-07)

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An experiment is described in which a normal shock interacts with the natural turbulent wall boundary layer in a parallel sided duct at Mach 1.3 and 1.5. The shock wave is vibrated in symmetric fashion by a rotating cam mounted in the tunnel diffuser. The design of this experiment, particularly, the efforts to obtain a pure forcing signal, is discussed. Shock motion analysis at reduced frequencies of order 0.2 to 2 and amplitude parameters of 2 to 20% (based on equivalent chord) is presented. Unsteady surface pressure measurements under the interaction were made and demonstrate that there is negligible phase change between the shock motion and the surface pressures. It appears reasonable to utilize quasi-steady assumptions in the calculation of the surface pressures at the low frequency conditions tested. Author

N87-21934# Cambridge Univ. (England). Whittle Lab.

MEASURED AND PREDICTED LOSS GENERATION IN TRANSONIC TURBINE BLADING

W. N. Dawes, J.-J. Camus, L. P. Xu, and C. G. Graham (Rolls-Royce Ltd., Bristol, England) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 11 p (For primary document see N87-21927 15-07)

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For a typical transonic turbine rotor blade, designed for use with coolant ejection, the trailing edge, or base loss is three to four times the profile boundary layer loss. The base region of such a profile is dominated by viscous effects and its seems essential to attack the problem of loss prediction by solving the compressible Navier-Stokes equations. However, such an approach is inevitably compromised by both numerical accuracy and turbulence modeling constraints. A Navier-Stokes solver written for 2D blade-blade flows and employing a simple two-layer mixing length eddy viscosity model are described. Then, measured and predicted losses and base pressures are presented for two transonic rotor blades and attempts are made to assess the capabilities of the Navier-Stokes solver and to outline areas for future work. Author

N87-21935# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

INFLUENCE OF SHOCK AND BOUNDARY-LAYER LOSSES ON THE PERFORMANCE OF HIGHLY LOADED SUPERSONIC AXIAL FLOW COMPRESSORS

K. D. Broichhausen and H. E. Gallus (Technische Hochschule, Aachen, West Germany) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 14 p (For primary document see N87-21927 15-07)

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Performance and losses of trans/supersonic axial flow compressors are influenced by shock structure, shock-boundary layer interactions and boundary layer separation. The combination of these phenomena and their effects on the flow characteristics of supersonic compressors are discussed. For this purpose experimental results are compared with theoretical approaches involving different semi-empirical correlations for shock and boundary layer losses, for separation and flow deviation. By an appropriate combination of these models the flow characteristics of supersonic compressors are interpreted and the performance of such compressors is successfully reproduced in a wide range. Finally, generally valuable statements on the design of highly loaded supersonic compressors are derived and possible perspectives are described. Author

N87-21936# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

SHOCK WAVES LOSSES ANALYSIS

Antoine Fourmaux and Alain LeMeur *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 11 p In FRENCH; ENGLISH summary (For primary document see N87-21927 15-07)

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In advanced technology turbomachinery design, reducing aerodynamic losses is an important matter. Schematically, these losses have 3 origins: losses related to the leading-edge shock; losses related to the main-compression shock; and friction losses, related to the boundary layer evolution. For given inlet and outlet conditions, a judicious designing of the blade profiles may induce a minimum loss level. In order to successfully conclude such a design, some rather experimental work was recently performed in ONERA, the main results of which are presented. Leading edge shock (the influence of the leading edge shape on the shock and on its impingement on the lower blade section surface); experimental analysis of a single blade-to-blade passage in order to validate certain principles concerning shock/boundary layer interaction; and experimental analysis of a cascade in which the

blade profile is specially designed to minimize the losses are examined. All projects were done on two-dimensional flow. The alternate use of theoretical and experimental methods will be emphasized. Author

N87-21937# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.

EXPERIMENTAL INVESTIGATIONS ON SHOCK LOSSES OF TRANSONIC AND SUPERSONIC COMPRESSOR CASCADES

H. A. Schreiber *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 15 p (For primary document see N87-21927 15-07)

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The losses of transonic and supersonic compressor bladings are due to viscous effects and due to entropy rises in shock waves arising in the entrance regions and passages of the blades. Depending on inlet Mach number, inlet flow angle, and back pressure the shock loss level reaches 40 to 70% of the overall losses. Most of the loss prediction models in use consider viscous and shock losses separately. However, very few quantitative experimental data of shock losses are available to verify these models. A separation of the viscous and shock losses is performed by the analysis of wake measurements behind some compressor cascades. The cascade tests were performed in the inlet Mach number range from 0.8 to 1.7. Detailed information is presented about the shock structure and the region of shock boundary layer interaction in the blade passage of a supersonic cascade obtained with the aid of laser anemometry. Author

N87-21938# Alfa Romeo S.p.A., Naples (Italy).

OPTIMISATION OF A TRANSONIC FLOW RADIAL VANED DIFFUSER

Salvatore Colantuoni and Rene VandenBraembussche (Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 10 p (For primary document see N87-21927 15-07)

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The transonic flow in an existing radial vaned diffuser was analyzed with a time dependent finite area calculation method. The calculated Mach number distribution indicates a strong bow shock upstream of the throat. Based on this experience, new diffusers were designed in order to optimize the Mach number distribution in the semi-vaneless space by designing for a shock-free deceleration. The best predictions are obtained with a modified version of the design method of Herbert and Came in which a radial change of difffuser width is incorporated. Experimental results obtained with this optimized design show an important increase in range and confirms the shock-free deceleration of the flow. The difference between the calculated and measured pressure distribution can be explained by incidence effect due to an incorrect estimation of the boundary layer blockage on the lateral walls. Better predictions will be possible only if a more precise definition of the real flow conditions at the diffuser inlet becomes available. Author

N87-21939# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

NUMERICAL VISCOUS-INVISCID INTERACTION METHOD FOR INTERNAL SEPARATED FLOWS AND SHOCK WAVE-BOUNDARY LAYER INTERACTION c34

J. C. LeBalleur and D. Blaise *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH; ENGLISH summary (For primary document see N87-21927 15-07)

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A calculation method for internal transonic separated flows, and for shock wave-boundary layer interactions, is presented. It is based on developments in indirect numerical solvers with viscous-inviscid splitting, well conditioned at high Reynolds numbers. The viscous flows are calculated with the defect formulation theory, here simplified with thin layers approximations compatible with an integral method. The direct and semi-inverse strong coupling methods, and the direct and inverse defect integral methods with turbulence models involving 0, 1, or 2 integral transport equations, which were previously suggested for airfoils flows, were generalized to internal flows for which the inviscid field requires the use of an Euler solver. Results are obtained for turbulent flows in transonic shocked channels with backpressure, involving multiple shock wave-boundary layer interactions, and incipient or extensive separations. The method is also applied to supersonic shock wave-boundary layer interactions, for compression ramps or shock wave-reflexions. First results obtained for computing viscous flows in cascades are presented. Author

N87-21940# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).

THREE-DIMENSIONAL COMPUTATION AROUND TURBO-MACHINE BLADES WITH FINS [CALCUL TRIDIMENSIONAL DANS LES AUBABES DE TURBO-MACHINES AVEC NAGEOIRE]

T. Derrien *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 15 p In FRENCH (For primary document see N87-21927 15-07)

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The numerical solution of the Euler equations governing the flow at finned blades of a rotating wheel is presented. An explicit domain method, selected for its simplicity, is used. The analysis of the computation results, comparing blades in the same conditions with and without fins, allowed the principle influences of the fins on the aerodynamic field to be revealed. M.G.

N87-21941# Stuttgart Univ. (West Germany). Inst. fuer Luftfahrtantriebe.

A QUASI THREE DIMENSIONAL METHOD FOR THE CALCULATION OF TRANSONIC FLOWS IN TURBOMACHINES

Joerg Haller *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 12 p (For primary document see N87-21927 15-07)

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A procedure based on the iterative coupling of flow calculations on S1 blade-to-blade stream surfaces and a flow calculation on an S2 hub-to-tip stream surface is described. The solutions on S1 surfaces of revolution are obtained by a time marching method in finite volume form, whereas a finite difference method is used for the S2 calculation. The finite difference method uses a stream function formulation based on a passage averaging technique in order to account for non-axisymmetric flows, especially with shocks inside a blade row. Sample calculations of a single-stage and a two-stage compressor are presented and compared with measurements. Author

N87-21942# Politecnico di Milano (Italy). Dipt. di Energetica.

TRANSONIC THREE-DIMENSIONAL INVISCID CALCULATIONS iN TURBOMACHINES

F. Bassi and M. Savini (National Center for Energetics and Propulsion, Peschiera Borromeo, Italy) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 10 p (For primary document see N87-21927 15-07)

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A finite volume Euler solver which was applied to the calculation of the three-dimensional transonic flow field through straight cascades is described. The numerical algorithm, based on Jameson's approach, uses a centered space discretization, with explicit adaptive dissipation terms, and a three-stage Runge-Kutta method for the time integration; the convergence to the steady state solution may be enhanced by using local time step, residual smoothing, and enthalpy damping. The calculations were performed in a O-type grid, obtained by means of a constructive approach which guarantees good properties of smoothness, orthogonality, and resolution near the body. The computational code was applied to two turbine blade cascades in transonic regime tested at the von Karman Institute. Three-dimensional effects were introduced by imposing an inlet velocity profile normal to the endwall. The computational results show good agreement with the blades

pressure experimental data and the code performed well in the prediction and development of the secondary flow vortices.
Author

N87-21943# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
COMPUTATION OF TRANSONIC 2D CASCADE FLOW AND COMPARISON WITH EXPERIMENTS
H.-W. Happel, H. J. Dietrichs, and K. Lehmann *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 19 p (For primary document see N87-21927 15-07)
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A time-marching finite area method to obtain the steady 2D blade-to-blade solution along an axisymmetric stream surface with changing radius and stream tube thickness is described. The conservation laws are solved in a rotating frame. The numerical scheme is explicit and first order accurate in time and space. To achieve stability, explicit numerical viscosity is added. Three alternative methods of ensuring the zero normal velocity condition along the solid walls are analyzed and their application is discussed. In order to increase the convergence speed, a sequential grid-refining procedure and a multiple-grid algorithm are used in the code. The accuracy and computational efficiency of the computer code are demonstrated for agreement for turbine and compressor cascades. Author

N87-21944# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
A NUMERICAL STUDY OF UNSTEADY FLOW EFFECTS IN A SUPERSONIC COMPRESSOR CASCADE
Scott M. Richardson *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 11 p (For primary document see N87-21927 15-07)
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Recent experimental evidence exists which suggests that compressor cascades operating supersonically may pass a higher mass flow with a periodic inflow condition than with the thermodynamically equivalent mass-averaged steady condition. Since most compressor design methods rely on the use of an axisymmetric analysis, any excursion in mass flow caused by blade row interactions will not be accounted for in the design. The two-dimensional Navier-Stokes equations are solved using the MacCormick explicit algorithm to obtain the flow in a subsonic rotor cascade for both periodic and steady flow inlet conditions. A outflow boundary condition is presented to model the unsteady cascade exit flow conditions by using localized heat addition to produce a choke point near the downstream boundary. A computational study of the wake model parameters used in the periodic inlet boundary condition is performed to determine their effect on the cascade mass flow swallowing capacity. Author

N87-21945# Cambridge Univ. (England). Whittle Lab.
A NUMERICAL STUDY OF THE 3D FLOWFIELD IN A TRANSONIC COMPRESSOR ROTOR WITH A MODELLING OF THE TIP CLEARANCE FLOW
W. N. Dawes *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 12 p (For primary document see N87-21927 15-07)
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Modeling the complex flowfield in a transonic axial compressor rotor is a considerable but worthwhile challenge for flow prediction methods. A computer code aimed at solving the equations of three dimensional viscous compressible flow in turbomachine geometries is described. The code is applied to the study of the flowfield in a transonic axial compressor rotor at design speed for both maximum flow and towards stall. The rotor was designed and tested using laser two-focus velocimetry. The rotor has a hub-tip ratio of 0.5 and design speed of 20,260 rpm. At the design point the rotor pressure ratio is 1.626 and the mass flow 17.1 kg/s. The predicted flowfield is compared with the laser measurements and the performance of the code discussed. In addition the discussion highlights the changes in the predicted endwall and tip clearance flows as the rotor operating point is moved towards stall. Author

N87-21946# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODELING HIGH REYNOLDS NUMBER INTERNAL FLOWS BY NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS [CALCUL D'ECOULEMENTS INTERNES A GRAND NOMBRE DE REYNOLDS PAR RESOLUTION NUMERIQUE DES EQUATIONS DE NAVIER-STOKES] c34
L. Cambier, B. Escande, and J.-P. Veuillot *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH Original language document was announced in IAA as A87-21030 (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

A finite difference approach is taken for solving the time-averaged Navier-Stokes equations for high-Re turbulent flows. Subgrid-scale features are incorporated into the calculations to account for phenomena in viscous thin layers, and a turbulence model which includes two transport equations is defined to describe turbulence along the mixing length. The spatial discretization is performed using the Green's function integrated along the flow contours. Results are provided from sample calculations for a Re = 80,000 flow through a row of compressor blades. Additionally, comparisons are made of different turbulence models for a shock wave-boundary layer interaction. IAA

N87-21947# Rolls-Royce Ltd., Bristol (England). Theoretical Science Group.
SOME TURBOMACHINERY BLADE PASSAGE ANALYSIS METHODS: RETROSPECT AND PROSPECT
D. Carrahar and T. R. Kingston *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 16 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

The development of time marching methods to analyze blades started at Rolls-Royce in the mid seventies, when sufficient computing power was becoming available. It was recognized that such methods had much to offer, especially for transonic and supersonic flows. Since then several different algorithms were developed to predict both quasi-3D and 3D flows. At present the time-marching methods are used to solve the unsteady Euler/Navier-Stokes equations to produce a time steady solution. Future developments are aimed towards predicting loss accurately, and to investigated unsteady effects such as vortex shedding and incoming wakes. Author

N87-21948# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DETERMINATION OF THE SUPERSONIC CASCADE ENTRANCE ZONE [DETERMINATION DE LA REGION DE CAPATION D'UN GRILLE D'AUBES SUPERSONIQUE] c34
Georges Meauze *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 12 p In FRENCH; ENGLISH summary (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

Incidence phenomenon, well known for supersonic straight cascades, is analyzed and extended in the general case of a cascade of a stream-surface with variable radius and thickness. The special configuration of a radial cascade is studied in detail. From this analysis, it is possible to point out some rules for the optimization of the entrance part of supersonic cascades.
Author

N87-21949# Technische Hochschule, Hanover (West Germany). Inst. fuer Stroemungsmaschinen.
DOWNSTREAM FLOW ANGLE CORRELATIONS FOR TURBINE CASCADES IN SUBSONIC AND TRANSONIC FLOW CONDITIONS
W. Riess, P. Dalbert, P.-A. Giess, and H.-J. Heinemann (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt,

Goettingen, West Germany) *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

Extensive experimental and theoretical investigations of different turbine cascades were performed within the transonic Mach number range. Some problems related to measurements in rectilinear cascades are discussed. The flow field calculations performed using a time-marching Euler code limitations can be determined when applying the computer code itself as well as when comparing the calculated data with experimental ones. Experimental and theoretical results within the subsonic Mach number range are used to check the accuracy of simplified methods for calculating the downstream flow angle. Author

N87-21950# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Antriebstechnik.
A SHOCK LOSS MODEL FOR SUPERCRITICAL SUBSONIC FLOWS IN TRANSONIC AXIAL FLOW COMPRESSORS
R. J. Dunker *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 15 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

This investigation was aimed at developing more sophisticated models to be incorporated in an off-design performance prediction method for transonic axial flow compressor stages for more accurate flow prediction. Primary emphasis was given to the improvement of shock models used for evaluating the shock losses, especially, at supercritical subsonic, but also at supersonic inflow conditions. The developed and refined methods were verified by calculating, investigating, and analyzing the losses of compressor cascades, as well as a transonic axial flow compressor. Author

N87-21951# KHD Luftfahrttechnik G.m.b.H., Oberursel (West Germany).
COMPARISON BETWEEN INVERSE DESIGNED (PVD) AIRFOILS AND STANDARD SERIES AIRFOILS FOR HIGH LOADED AXIAL TURBINE NOZZLE APPLICATION
M. Horsmann and M. Schmidt *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 6 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

Guide vane profiles with transonic flow regions in the flow field were developed for a high loaded one stage axial turbine. The profiles were designed in two different ways: first, using standard design techniques and second, using an inverse design method, where the profile shape is computed from prescribed velocity distributions (PVD). The results of both design methods will be presented. Comparison is made by using another computer program system to calculate the velocity distributions in the flow field, the boundary layer parameters, and the profile losses. The computed results of the first application of an inverse design method on axial turbine guide vanes show that improvements can be made. Author

N87-21952# National Aeronautical Lab., Bangalore (India). Propulsion Div.
DESIGN OF AN AXIAL FLOW RESEARCH COMPRESSOR OPERATING IN THE SUBSONIC AND TRANSONIC RANGES
K. Mohan Nov. 1986 25 p
(NAL-TM-PR-8607) Avail: NTIS HC A02/MF A01

A high speed axial flow research compressor, indigenously designed and fabricated, has been installed and commissioned. This fully operational compressor is meant for undertaking investigations on models of axial flow compressor stages in the subsonic, transonic and supersonic flow ranges. The compressor rotor is 450 mm in diameter and the maximum possible operating speed is 18,000 r.p.m. Investigations on compressor stages of widely varying geometric configurations can be undertaken with provision to vary different aerodynamic flow parameters, as and when required. Thus, most of the aerothermodynamic investigations related to the advanced technology compressors required for modern aircraft engines and industrial gas turbine power plants can be undertaken in this versatile research compressor. The performance capabilities and operational characteristics of this research compressor, which has been satisfactorily running since its commissioning, are presented. Author

N87-21953# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENT ON A CYLINDRICAL SCRAMJET COMBUSTOR. 1: SIMULATED FLIGHT MACH NUMBER OF 4.4
Tomoyuki Komuro, Atsuo Murakami, Kenji Kudou, Goro Masuya, and Nobuo Chinzei 1986 17 p In JAPANESE; ENGLISH summary
(NAL-TR-918; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

An experimental study was made on a cylindrical scramjet combustor with a step using vitiated air. The stagnation temperature and the pressure of the vitiated air were 1000 K and 1.5 MPa, respectively. Simulated flight speed was Mach 4.4 at a simulated altitude of 20 km. Perpendicular injection showed better mixing performance than did parallel injection. As equivalence increased, supersonic combustion was switched to subsonic combustion. Mixing in the supersonic combustion mode was very slow compared with that in subsonic mode. Author

N87-21954# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL INVESTIGATION OF TEMPERATURE AND GAS COMPOSITION IN A CAN TYPE GAS TURBINE COMBUSTION CHAMBER WITH DIFFERENT FUEL INJECTION DIRECTIONS
T. Tamaru and H. Yamada 1986 48 p In JAPANESE; ENGLISH summary
(NAL-TR-906; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The direction of fuel injection in a gas turbine combustor produces significant effects on the performance. Effects on the flame blow-off characteristics are especially large. Combustion by two kinds of fuel injection nozzles in the same combustion liner was investigated experimentally by measuring the temperature and gas composition. The combustor using the fuel nozzle which injects fuel inward around the center axis showed good performance under weak mixture conditions but exhibited a sudden flame blow-off at equivalence ratio 0.30 under high pressure conditions. Present results reveal that it has a poor flame holding structure without recirculation of hot gas under moderate mixture conditions, whereas it has a stable diffusion type flame under lean mixture conditions. The accuracy and the nature of the temperature obtained and the gas concentration data are discussed. Author

N87-21955*# Hamilton Standard, Windsor Locks, Conn.
UNSTALLED FLUTTER STABILITY PREDICTIONS AND COMPARISONS TO TEST DATA FOR A COMPOSITE PROP-FAN MODEL Final Report
J. E. Turnberg 15 Oct. 1986 50 p
(Contract NAS3-24088)
(NASA-CR-179512; NAS 1.26:179512; HSER-11056) Avail: NTIS HC A03/MF A01 CSCL 21E

The aeroelastic stability analyses for three graphite/epoxy composite Prop-Fan designs and post-test stability analysis for one of the designs, the SR-3C-X2 are presented. It was shown that Prop-Fan stability can be effectively analyzed using the F203 modal aeroelastic stability analysis developed at Hamilton Standard and that first mode torsion-bending coupling has a direct effect on blade stability. Positive first mode torsion-bending coupling is a destabilizing factor and the minimization of this parameter will increase Prop-Fan stability. It was also shown that Prop-Fan stability analysis using F203 is sensitive to the blade modal data used as input. Calculated blade modal properties varied significantly with the structural analysis used, and these variations are reflected in the F203 calculations. Author

N87-21956*# Hamilton Standard, Windsor Locks, Conn.
DYNAMIC RESPONSE AND STABILITY OF A COMPOSITE PROP-FAN MODEL Final Report
A. F. Smith and B. M. Brooks Oct. 1986 92 p
(Contract NAS3-24088)

(NASA-CR-179528; NAS 1.26:179528; HSER-11057) Avail: NTIS HC A05/MF A01 CSCL 21E

Results are presented for blade response and stability during wind tunnel tests of a 62.2 cm diameter model of a prop-fan, advanced turboprop, with swept graphite/epoxy composite blades. Measurements of dynamic response were made with the rotor mounted on an isolated nacelle, with varying tilt for nonuniform inflow, at flow speeds from 0.36 to 0.9 Mach number. The blade displayed no instabilities over the operating range tested, up to 0.9 Mach number and 10,000 RPM. Measurements are compared with those for other prop-fan models of both solid metal and graphite composite construction. The swept composite blade had less response than an unswept composite blade. Composite blades had more response than metal blades. Measurements are compared with theoretically based predictions. The 1-P blade response was significantly overpredicted using unimproved methods and somewhat overpredicted using improved methods. Unexpectedly high 2-P strain levels were measured and suggest the presence of nonlinear effects on blade response. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N87-21957*# California Univ., Los Angeles.

AEROELASTIC EFFECTS IN MULTIROTOR VEHICLES. PART 2: METHODS OF SOLUTION AND RESULTS ILLUSTRATING COUPLED ROTOR/BODY AEROMECHANICAL STABILITY

C. Venkatesan and P. P. Friedmann Washington NASA Feb. 1987 184 p

(Grant NAG2-116)

(NASA-CR-4009; NAS 1.26:4009) Avail: NTIS HC A09/MF A01 CSCL 01C

This report is a sequel to the earlier report titled, Aeroelastic Effects in Multi-Rotor Vehicles with Application to Hybrid Heavy Lift System, Part 1: Formulation of Equations of Motion (NASA CR-3822). The trim and stability equations are presented for a twin rotor system with a buoyant envelope and an underslung load attached to a flexible supporting structure. These equations are specialized for the case of hovering flight. A stability analysis, for such a vehicle with 31 degrees of freedom, yields a total of 62 eigenvalues. A careful parametric study is performed to identify the various blade and vehicle modes, as well as the coupling between various modes. Finally, it is shown that the coupled rotor/vehicle stability analysis provides information on both the aeroelastic stability as well as complete vehicle dynamic stability. Also presented are the results of an analytical study aimed at predicting the aeromechanical stability of a single rotor helicopter in ground resonance. The theoretical results are found to be in good agreement with the experimental results, thereby validating the analytical model for the dynamics of the coupled rotor/support system. Author

N87-21958# Dynamic Controls, Inc., Dayton, Ohio.

RESEARCH AND DEVELOPMENT OF AIRCRAFT CONTROL ACTUATION SYSTEMS Final Report, May 1979 - Feb. 1985

Carl N. Allbright, Gavin D. Jenney, Harry W. Schreadley, and William G. Talley Dec. 1986 175 p

(Contract F33615-79-C-3602)

(AD-A177491; AFWAL-TR-86-3070) Avail: NTIS HC A08/MF A01 CSCL 01C

Described are the design and test of a multipurpose actuation test rig to be used for loaded evaluation of actuation systems with rotary outputs and/or integrated as part of wing structure. It also describes a hydromechanical flutter damping module for an F-4 stabilator actuator. The module incorporates design improvements based on previous test results. Development and test results of a linear force motor based on a moving magnet concept, and the measured performance characteristics of the concept over a range of parameter variations are presented. A method of force enhancement for direct drive force motors and the corresponding test results applied to a moving coil force motor are described. The concept is based on applying a limited time duration pulse to the force motor in order to increase the force output when required. The logic technique used to initiate the pulse application is presented. Applying a digital computer as a controller for an analog electrohydraulic control system requires consideration of the interface used. The effect of a pulse width modulation interface on the life of analog electrohydraulic hardware is presented. There is a potential for reducing the pumping capacity of an aircraft's flight control hydraulic system by using accumulators to store hydraulic energy. The results of a study using this approach and an F-16 simulation are presented. GRA

N87-21959# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

QFT (QUANTITATIVE FEEDBACK THEORY) DIGITAL FLIGHT CONTROL DESIGN AS APPLIED TO THE AFTI/F16 M.S. Thesis

Dean L. Schneider Dec. 1986 340 p

(AD-A177744; AD-E751201; AFIT/GE/ENG/86D-4) Avail: NTIS HC A15/MF A01 CSCL 09D

Quantitative Feedback Theory (QFT) has been shown to adequately synthesize compensators for a variety of continuous time systems. An investigation was made to extend QFT to sampled-data systems via a pseudo-continuous time approach. This investigation resulted in the satisfaction of specifications as in the continuous case for a transport aircraft (KC-135) but not for a fighter aircraft (AFTI/F-16). This thesis attempts to extend QFT to the discrete multiple-input, multiple-output (MIMO) problem by utilizing the w' transformation from the discrete z-domain plant. The remainder of the first chapter presents a statement and the scope of the problem, the assumptions made, the approach taken, and the sequence of presentation for the rest of the thesis. Throughout the thesis, the author assumes the reader is familiar with continuous MIMO QFT techniques and, therefore, only differences from the continuous design procedure are noted. GRA

N87-21960*# Minnesota Univ., Minneapolis.

EIGENSPACE TECHNIQUES FOR ACTIVE FLUTTER SUPPRESSION

William L. Garrard, Bradley S. Liebst, and Jerome A. Farm Washington NASA Jun. 1987 73 p

(Grant NAG1-217)

(NASA-CR-4071; NAS 1.26:4071) Avail: NTIS HC A04/MF A01 CSCL 01C

The use of eigenspace techniques for the design of an active flutter suppression system for a hypothetical research drone is discussed. One leading edge and two trailing edge aerodynamic control surfaces and four sensors (accelerometers) are available for each wing. Full state control laws are designed by selecting feedback gains which place closed loop eigenvalues and shape closed loop eigenvectors so as to stabilize wing flutter and reduce gust loads at the wing root while yielding accepatable robustness and satisfying constrains on rms control surface activity. These controllers are realized by state estimators designed using an eigenvalue placement/eigenvector shaping technique which results in recovery of the full state loop transfer characteristics. The resulting feedback compensators are shown to perform almost as well as the full state designs. They also exhibit acceptable performance in situations in which the failure of an actuator is simulated. B.G.

N87-21961*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A SIMULATION INVESTIGATION OF SCOUT/ATTACK HELICOPTER DIRECTIONAL CONTROL REQUIREMENTS FOR HOVER AND LOW-SPEED TASKS

Courtland C. Bivens (Army Aviation Research and Development Command, Moffett Field, Calif.) and Joseph G. Guercio Mar.

1987 299 p
(NASA-TM-86755; A-85257; USAAVSCOM-TR-85-A-11; NAS 1.15:86755) Avail: NTIS HC A13/MF A01 CSCL 01C

A piloted simulator experiment was conducted to investigate directional axis handling qualities requirements for low speed and hover tasks performed by a Scout/Attack helicopter. Included were the directional characteristics of various candidate light helicopter family configurations. Also, the experiment focused on conventional single main/tail rotor configurations of the OH-58 series aircraft, where the first-order yaw-axis dynamic effects that contributed to the loss of tail rotor control were modeled. Five pilots flew 22 configurations under various wind conditions. Cooper-Harper handling quality ratings were used as the primary measure of merit of each configuration. The results of the experiment indicate that rotorcraft configurations with high directional gust sensitivity require greater minimum yaw damping to maintain satisfactory handling qualities during nap-of-the-Earth flying tasks. It was also determined that both yaw damping and control response are critical handling qualities parameters in performing the air-to-air target acquisition and tracking task. Finally, the lack of substantial yaw damping and larger values of gust sensitivity increased the possibility of loss of directional control at low airspeeds for the single main/tail rotor configurations. Author

N87-21901# Technische Univ., Brunswick (West Germany). Inst. for Guidance and Control.
DESIGN CRITERIA FOR MULTI-LOOP FLIGHT CONTROL SYSTEMS
G. Schaenzer *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 12 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N87-21962# Air War Coll., Maxwell AFB, Ala.
THE IMPACT OF TECHNOLOGY ON FLIGHT SIMULATION
Anthony J. Tolin May 1986 26 p
(AD-A177861; AU-AWC-86-213) Avail: NTIS HC A03/MF A01 CSCL 05I

Remarks on the debate of flying time versus simulator time introduce a discussion on the impact of technology in flight simulation. A brief look at the history of flight simulators is followed by a more detailed analysis of where the Air Force is today with regard to flight simulation. This analysis looks at the advantages of simulators, the choice between motion and visual systems, and addresses several problems and issues. After a discussion of the future in flight simulation, the conclusion that simulation is here to stay as a complement, not a replacement for, actual flying hours is developed. GRA

N87-21963*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ONE-FIFTIETH SCALE MODEL STUDIES OF 40-BY 80-FOOT AND 80-BY 120-FOOT WIND TUNNEL COMPLEX AT NASA AMES RESEARCH CENTER
Gene I. Schmidt, Vernon J. Rossow, Johannes vanAken (Kansas Univ., Lawrence.), and Cynthia L. Parrish Apr. 1987 49 p
(NASA-TM-89405; A-86438; NAS 1.15:89405) Avail: NTIS HC A03/MF A01 CSCL 14B

The features of a 1/50-scale model of the National Full-Scale Aerodynamics Complex are first described. An overview is then given of some results from the various tests conducted with the model to aid in the design of the full-scale facility. It was found that the model tunnel simulated accurately many of the operational characteristics of the full-scale circuits. Some characteristics predicted by the model were, however, noted to differ from previous full-scale results by about 10%. Author

N87-21964# Texas A&M Univ., College Station. Transportation Inst.
CRITERIA FOR ASPHALT-RUBBER CONCRETE IN CIVIL AIRPORT PAVEMENTS. VOL. 2: EVALUATION OF ASPHALT-RUBBER CONCRETE Final Report, Sep. 1983 - Mar. 1987
Denise M. Hoyt, Robert L. Lytton, and Freddy L. Roberts Mar. 1987 241 p
(Contract DTFA01-83-C-30076)
(DOE/FAA/PM-86/39-Vol-2) Avail: NTIS HC A11/MF A01

Asphalt-rubber concrete and an asphalt concrete control were tested in the laboratory and materials characterizations were generated, including Marshall Stability, resilient modulus, fatigue and fracture properties, creep compliance, and permanent deformation properties. The characterization parameters and an airport runway model for a municipal airport were input into the modified ILLIPAVE computer program for analysis of rutting and cracking damage and the relative lives of the materials in each of four climatic zones. An economic evaluation was then performed comparing the costs and service lives of each material in each zone. Author

N87-21965# Pavement Consultancy Services, Inc., College Park, Md.
PERFORMANCE OF CRACKED AND SEATED RIGID AIRPORT PAVEMENTS Final Report
G. R. Rada and M. W. Witczak Apr. 1987 81 p
(Contract DTFA01-86-P-08004)
(DOT/FAA/PM-87/4) Avail: NTIS HC A05/MF A01

Despite the growing popularity of the crack and seat technique, little guidance is available for use in evaluating and designing overlays for cracked and seated airfield pavements. A case study was undertaken to compare in-situ characteristics and overlay requirements of three different pavement sections at Suffolk Municipal Airport, Va. Nondestructive testing (NDT) was used to determine the in-situ pavements properties and visual surveys were conducted to assess the condition rating of the pavements. The results of the NDT testing program were used to predict and compare the Portland Cement Concrete (PCC) layer moduli and the design Asphaltic Concrete (AC) overlays. The results indicate that: (1) while the use of the crack and seat technique appears to be effective, reflective cracking is not eliminated; (2) the strength of the PCC layer is significantly reduced after cracking and seating and hence, thicker AC overlays are required; and (3) a greater degree of cracking before placing the overlay would have been useful. Author

N87-21966# Aeronautical Research Labs., Melbourne (Australia).
AN IMPROVED STRAIN GAUGE TRANSDUCER AMPLIFIER FOR WIND TUNNEL USE
N. Pollock 1986 26 p
(ARL-AERO-R-170; AR-004-494) Copyright Avail: NTIS HC A03/MF A01

An ac excited self-balancing instrument for measuring low level strain gauge transducer outputs is described. The design of a specific circuit optimized for use with a small wind tunnel force balance is presented with sufficient information to facilitate circuit optimization for other applications. The instrument is intended for applications where the bridge output voltage is below the level that can be conveniently handled by conventional dc amplifier systems. Tests on a prototype instrument showed an input noise in a 0.1 Hz to 0.7 Hz bandwidth of 4 nV RMS, a zero drift of less than 0.1 microvolt per day and negligible drifts. Author

N87-21967# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.
ANALYSIS OF A SPECIAL SHORT WIND TUNNEL INTERNAL STRAIN GAUGE BALANCE AND COMPARISON WITH EXPERIMENTAL CALIBRATION DATA
S. R. Patil, K. S. Raman, and M. A. Ramaswamy (Indian Inst. of Science, Bangalore.) Aug. 1986 42 p
(NAL-TM-AE-8607) Avail: NTIS HC A03/MF A01

A detailed analysis of a special short wind tunnel internal strain gauge balance is presented. It mainly involves the static analysis of the indeterminate structure both by the method of superposition and strain energy method. Calibration constants of the balance were evaluated by the analysis. These results were compared with the experimental results which were determined by actual calibration of the balance. The general procedure adopted can be used for the analysis of other wind tunnel balances. Author

N87-21968# National Aerospace Lab., Tokyo (Japan).
AN EXPERIMENTAL STUDY ON THE THRESHOLD OF ROLL PERCEPTION
Hiroyasu Kawahara, Naoki Isu, and Takao Mimura 1986 24 p In JAPANESE; ENGLISH summary
(NAL-TR-905; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

In order to improve the driving algorithm of the moving base of a flight simulator, some basic characteristics concerning perception of roll motion were investigated. Thresholds of roll perception were examined by rolling subjects from an upright position and from several angles of initial tilt to upright. It was confirmed that the threshold of roll perception is represented by the roll angle in the range in which flight simulators are usually driven. The threshold of roll detection from an upright position was 0.78 deg. Those from a position of initial tilt increased in proportion to the angle of the initial tilt. Sensation of static tilt was also estimated by asking subjects to indicate the vertical direction. The tilt angle was perceived to be larger than the physical tilt in the range of less than 7 deg., while it was perceived to be smaller at larger angles. Author

N87-21969# National Aerospace Lab., Tokyo (Japan).
TRIAL MANUFACTURE OF NAL 0.1m X 0.1m TRANSONIC CRYOGENIC WIND TUNNEL
Kazuaki Takashima, Hideo Sawada, Takeo Aoki, and Shigeo Kayaba 1986 58 p In JAPANESE; ENGLISH summary
(NAL-TR-910; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

In order to study the cryogenic wind tunnel, in which high Reynolds number tests can be conducted, a small transonic cryogenic wind tunnel was constructed. The construction and the operational results are described. This small cryogenic wind tunnel, with a test section of 0.1m x 0.1m, was built to ascertain the basic design specifications for a large transonic cryogenic wind tunnel which will be constructed in the future, and also to gain skill in operating the cryogenic wind tunnel. The capability of this wind tunnel is from stagnation temperature down to -173 C, for Mach numbers ranging from 0.4 to 1.02 and for a unit Reynolds number up to 1.3 x 1 million/cm with more than one hour running time. The design concept is first briefly given, then, the complete system i.e., the wind tunnel, the liquid nitrogen supply system, the gas nitrogen exhaust system, the thermal insulation device, the fan and the drive motor and the instrumentation and operating system are described in detail. Finally, the experimental results are discussed. The conclusion is that cryogenic wind tunnel operation can be safely and successfully conducted. Author

N87-21970# National Aerospace Lab., Tokyo (Japan).
AN AIR HEATER FOR SCRAMJET COMBUSTOR TEST
Atsuo Murakami, Tomoyuki Komuro, Kenji Kudou, Goro Masuya, and Nobuo Chinzei 1986 14 p In JAPANESE; ENGLISH summary
(NAL-TR-912; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

An air heater with vitiation by hydrogen for use in scramjet combustor ground tests was designed, manufactured, tested, and improved. Oxygen fraction distribution in the heater exit plane was made uniform by injecting oxygen into the air feed line. Hydrogen and temperature distributions were made uniform by increasing the number of hydrogen injector elements, arranging them uniformly, and adjusting their orifice diameters. Oscillatory combustion was observed in the early design of the heater, but it was stabilized by attaching suitable flame holders to the tips of the hydrogen injector elements. Author

N87-22354*# United Air Lines, Inc., Denver, Colo.
IMPLEMENTATION OF TURBULENCE MODELS INTO SIMULATORS
Robert L. Ireland *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 179-180 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N87-21971*# National Aeronautics and Space Administration, Washington, D.C.
HALLEY'S COMET EXPLORATION AND THE JAPANESE USUDA LARGE ANTENNA
T. Nomura et al. Sep. 1986 24 p Transl. into ENGLISH from the Journal of the Institute of Electronics and Communication Engineers (Japan), v. 67, no. 10, Oct. 1984 p 1039-1044 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4004)
(NASA-TM-88518; NAS 1.15:88518) Avail: NTIS HC A02/MF A01 CSCL 22A

An overview of the Japanese PLANET-A project to investigate Halley's Comet is given. The objectives and scientific challenges involved in the project are given, and the nature of the contribution made by the large antenna array located at Usuda-Cho, Nagano Prefecture, Japan is discussed. The structural design of the MS-T5 and PLANET-A probes are given, as well as the tracking and control network for the probes. The construction, design, operating system and site selection for the Usuda antenna station are discussed. Author

N87-21972# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SPACE
19 Feb. 1987 243 p Transl. into ENGLISH from various Russian articles
(JPRS-USP-87-001) Copyright Avail: NTIS HC A11/MF A01

Topics addressed include: manned mission highlights; space sciences; interplanetary sciences; life sciences; space engineering; space applications; space policy and administration; and launch schedule. For individual titles, see N87-21973 through N87-21980.

N87-21973# Joint Publications Research Service, Arlington, Va.
STATUS OF ORBITAL ASTRONOMY PROJECTS
Ye. Nelepo *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 11-12 Transl. into ENGLISH from Trud (Moscow, USSR), 25 Oct. 1986 p 3 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

Plans for orbiting spacecraft with telescopes for radio, gamma-ray, and X-ray astronomy are reported. One radio astronomy project involves an interferometric system of interactive ground and space telescopes. An X-ray observatory is being developed for the orbiting station Mir. Granat, an orbiting observatory, will measure hot plasmas in clusters of galaxies, X-ray pulsars, and regions surrounding black holes. B.G.

N87-21974# Joint Publications Research Service, Arlington, Va.
KOVTUNENKO ON PHOBOS MISSION PROFILE, NEW SPACECRAFT DESIGN c18
V. Kovtunenko *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 62-65 Transl. into ENGLISH from Pravda (Moscow, USSR), 20 Oct. 1986 p 7 (For primary document see

N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

As already reported, in the Soviet Union preparations are being made for an international space experiment which was given the name Phobos. The interplanetary automatic station developed within the framework of this project is to execute an expedition to Mars for implementation of a multipurpose task: investigation of the Martian satellite Phobos, Mars itself, space, and the sun. The beginning of the expedition was planned for Jyly 1988. The flight to Mars will require 200 days. Author

N87-21975# Joint Publications Research Service, Arlington, Va.
SPACECRAFT DATA AID IN DESCRIBING VENUS'S GEOLOGY **c91**

Valeriy Leonidovich Barsukov *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 71-85 Transl. into ENGLISH from Priroda (Moscow, USSR), no. 6, Jun. 1986 p 24-35 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

Astronomers have studied Venus for several hundred years. Recently it has become the object of intense study by means of spacecraft. Geologico-morphological research holds the key to Venus. Photography of the surface, plains, mountains, and craters are examined. Radar images of Venera-15 and Venera-16, and data from Vega-1 and Vega-2 are being analyzed to further map Venus. B.G.

N87-21976# Joint Publications Research Service, Arlington, Va.
ATMOSPHERE OF VENUS: NEW FINDINGS **c91**

Vasiliy Ivanovich Moroz *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 86-103 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 3, May - Jun. 1986 p 19-30 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

The atmosphere of a planet reacts subtly to external influences and it is necessary to study well the mechanisms of these changes in order not only to learn the planet's past, but also to be able to predict its future. The basic research for such an endeavo is discussed. The design of the spacecraft and payload equipment for atmospheric composition study are examined. B.G.

N87-21977# Joint Publications Research Service, Arlington, Va.
YEAR-LONG HYPOKINESIA EXPERIMENT IN PROGRESS: DAILY LIFE OF PARTICIPANTS DESCRIBED **c52**

L. Repin *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 121-126 Transl. into ENGLISH from Kosmolskaya Pravda (Moscow, USSR), 10 Aug. 1986 p 4 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

Ten volunteer subjects were tested to determine the effects of hypokinesia on the body, by being immobilized for an extended period. Interviews with four of the test subjects are presented. B.G.

N87-21978# Joint Publications Research Service, Arlington, Va.
SATELLITE COMMUNICATIONS TODAY **c32**

Yu. B. Zubarev *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 155-164 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 3, May - Jun. 1986 p 37-43 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

Satellites have opened up prospects for the development of communications, television, and radio broadcasting systems. The area of applications of these systems were expanded and possibilities have appeared. The history of the development of communications systems is discussed along with its advantages and shortcomings. Development prospects are examined. The implementation of the developments will make it possible to raise the technical level of satellite communications systems and to increase the number of services which can be offered to the people by the communications industry, as well as to improve the quality of an individual services for the country, especially its eastern region. B.G.

N87-21979# Joint Publications Research Service, Arlington, Va.
PLANS FOR INDUSTRIALIZATION OF SPACE DISCUSSED **c29**

V. S. Avduyevskiy *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 165-174 Transl. into ENGLISH from Zemlya i Vselennaya (Mowcow, USSR), no. 2, Mar. - Apr. 1986 p 2-9 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

The report by M. S. Borbachev, General Secretary of the CPSU Central Committee, on November 27, 1985, to the session of the USSR Supreme Soviet mentioned a comprehensive program for peaceful collaboration in space and the prospects for the industrial exploitation of space in the interests of all humanity. This program is a peaceful alternative to the misanthropic plans for the militarization of space. It includes the conducting of basic research in space, the creation of global systems of communications satellites, the study of the climate and the environmnet, the development of the science of space materials and medicine, and the creation of new space technology, including orbital scientific stations and manned spacecraft. What can such a program give to humanity if it is realized in the course of the next 25 years of the space era? The answer to this question is considered. Author

N87-21980# Joint Publications Research Service, Arlington, Va.
POSSIBILITIES OF USING ARTIFICIAL EARTH SATELLITE DATA FOR COMPUTING HEAT EXCHANGE BETWEEN THE OCEAN AND ATMOSPHERE IN NEWFOUNDLAND ENERGY-ACTIVE ZONE DURING WINTER **c48**

D. G. Rzheplinskiy and N. N. Shvyrkov *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 180-181 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1986 p 32-41 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

Maps of the dynamic topography of the ocean surface in the Newfoundland Energy-Active Zone (NEAZ) were plotted on the basis of three oceanographic surveys made during the winter of 1983 to 1984. During the first survey the main flow of the Gulf Stream at 50 degrees longitude was traced in the latitude zone from 38 to 43 deg N. The second survey revealed no significant changes in circulation and temperature distribution in the test range. Observations made during the third survey confirmed the presence of the main forms of circulation in the region. The test range was regionalized on the basis of types of vertical distribution of temperature and salinity for determining the limits of propagation of different water structures. Three types of vertical structures were defined: structure of slope waters, structure of transformation zone, and vertical North Atlantic structure. It was found that the intensity of the heat flows between the ocean and atmosphere in the NEAZ in winter is dependent largely on the position of the hydrological front separating the North Atlantic central water mass from the remaining water structures and on the specific meteorological synoptic situation. Author

N87-21981*# National Aeronautics and Space Administration, Washington, D.C.
[ROENTGEN SATELLITE (ROSAT)] Status Report, 1 Apr. - 30 Jun. 1986

Sep. 1986 42 p Transl. into ENGLISH of "Statusbericht, 2nd Quarter 1986" Rept. TN4/0435 DFVLR, West Germany, 30 Jun. 1986 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-88576; NAS 1.15:88576; TN4/0435) Avail: NTIS HC A03/MF A01 CSCL 22A

As result of the Challenger accident, the alternative possibility for launch of the ROSAT mission with an Atlas/Centaur launch vehicle is being considered. An overview of the problems involved in having the ROSAT flight ready for either a Shuttle or Atlas/Centaur launch is presented. B.G.

N87-21982 Ohio State Univ., Columbus.
ON ORBITAL ALLOTMENTS FOR GEOSTATIONARY SATELLITES Ph.D. Thesis
David Joseph Antony Gonsalvez 1986 155 p
Avail: Univ. Microfilms Order No. DA8703545

Satellite system synthesis consists of allocating orbit locations, frequency channels, and polarizations to satellites that transmit signals to service areas. The problem of assigning orbit locations to geostationary satellites is considered. Position assignments are to be made so as not to exceed specified acceptable interference levels that are stated in terms of conservative minimum required orbital separations between pairs of satellites. The objective function is the minimization of the total deviation of assigned orbit locations from corresponding specified desired locations. Four solution methods are proposed--mixed integer programming; Benders decomposition; linear programming with restricted basis entry; and a new switching heuristic. The switching algorithn combines an interchange heuristic and the simplex method for linear programming. Experimental results on seven test problems show that the switching heuristic is superior to the other methods in terms of solution quality, as measured by the objective function, and computation time. Variations of the satellite location problem are also examined. Dissert. Abstr.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N87-21983# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
ON-ORBIT OBSERVATIONS OF SINGLE EVENT UPSET IN HARRIS HM-6508 1K RAMS, REISSUE A
J. B. Blake and R. Mandel 1 Feb. 1987 20 p Supersedes AD-A176280
(Contract F04701-85-C-0086)
(AD-A177208; TR-0086(6940-05)-11; SD-TR-86-99) Avail: NTIS HC A02/MF A01 CSCL 09B

The Harris HM-6508 1K x 1 RAMs are part of a subsystem of a satellite in a low, polar orbit. The memory module, used in the subsystem containing the RAMs, consists of three printed circuit cards, with each card containing eight 2K byte memory hybrids, for a total of 48K bytes. Each memory hybrid contains 16 HM-6508 RAM chips. On a regular basis all but 256 bytes of the 48K bytes are examined for bit errors. Two different techniques were used for detecting bit errors. The first technique, a memory check sum, was capable of automatically detecting all single bit and some double bit errors which occurred within a page of memory. A memory page consists of 256 bytes. Memory check sum tests are performed approximately every 90 minutes. To detect a multiple error or to determine the exact location of the bit error within the page the entire contents of the memory is dumped and compared to the load file. Memory dumps are normally performed once a month, or immediately after the check sum routine detects an error. Once the exact location of the error is found, the correct value is reloaded into memory. After the memory is reloaded, the contents of the memory location in question is verified in order to determine if the error was a soft error generated by an SEU or a hard error generated by a part failure or cosmic-ray induced latchup. GRA

N87-21984*# Texas Univ., Austin. Center for Space Research.
GEOPHYSICAL PARAMETERS FROM THE ANALYSIS OF LASER RANGING TO STARLETTE Annual Research Technical Report, 15 Mar. 1986 - 14 Mar. 1987
B. E. Schutz and C. K. Shum 29 May 1987 12 p
(Grant NAG5-757)
(NASA-CR-180596; NAS 1.26:180596) Avail: NTIS HC A02/MF A01 CSCL 22A

Starlette Satellite Laser Ranging (SLR) data were used, along with several other satellite data sets, for the solution of a preliminary gravity field model for TOPEX, PTGF1. A further improvement in the earth gravity model was accomplished using data collected by 12 satellites to solve another preliminary gravity model for TOPEX, designated PTGF2. The solution for the Earth Rotation Parameter (ERP) was derived from the analysis of SLR data to Starlette during the MERIT Campaign. Starlette orbits in 1976 and 1983 were analyzed for the mapping of the tidal response of the earth. Publications and conference presentations pertinent to research are listed. B.G.

N87-21985# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
OPTIMIZATION OF THE POSITIONING OF GEOSTATIONARY SATELLITES BY THE FRACTIONAL APOGEE MANEUVER. DYNAMIC PROGRAMMING APPROACH Ph.D. Thesis - Toulouse Univ., France
Philippe Desroches 1987 150 p In FRENCH; ENGLISH summary
(LAAS-87-003; ETN-87-99540) Avail: NTIS HC A07/MF A01

The dynamic programming method is introduced in the Minoux version, based on mathematical programming. The evolution equations, the criteria, and the constraints are described and analyzed. The solution is obtained by iteration fixing at each step of the quantization parameter set for the dynamic programming procedure. ESA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N87-21986# Institut Francais du Petrole, Paris (France).
THE LIGHT GAS GUN: A SIMULATOR FOR INTERIOR BALLISTIC FLOWS
H. Mach and D. Hensel 16 May 1986 11 p Presented at the 9th International Symposium on Ballistics, Schrivenham, England, 29-Apr.-1 May 1986
(Contract BMVg-T/R-760/F-0008/F-1708)
(ISL-CO-214/86; ETN-87-99635) Avail: NTIS HC A02/MF A01

For experimental validation tests of the potential of interior ballistic computer models a simulation facility of 20 mm caliber was set up. It consists of a slightly modified two-stage light gas gun. Test gas was a mixture of H2 and He. Care was taken to make the thermodynamic state of the high pressure, high temperature gas ($p = 380$ MPa, $T = 2100$ K, $V = 100$ cc) as homogeneous and well-defined as possible. This is necessary for adequate predicting of subsequent development of the gas flow behind the projectile from a measurement of this state using the axisymmetric AMI computer code. In the experiments pressure, gas temperature, and gas velocity were measured at various locations along the tube. A comparison between measured and predicted values shows good agreement. ESA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N87-21987*# Martin Marietta Aerospace, Denver, Colo.
NEAR-FIELD TESTING OF THE 5-METER MODEL OF THE TETRAHEDRAL TRUSS ANTENNA
Neill Kefauver, Tom Cencich, Jim Osborn, and J. T. Osmanski Aug. 1986 167 p

(Contract NAS1-18016)
(NASA-CR-178147; NAS 1.26:178147; MCR-85-640) Avail: NTIS HC A08/MF A01 CSCL 22B

This report documents the technical results from near-field testing of the General Dynamics 5-meter model of the tetrahedral truss antenna at the Martin Marietta Denver Aerospace facility. A 5-meter square side of the tetrahedral served as the perimeter of the antenna, and a mesh surface and extensive surface contouring cord network was used to create a parabolic aperture shape to within an rms accuracy of 30 mils or better. Pattern measurements were made with offset feed systems radiating at frequencies of 7.73, 11.60, 2.27, and 4.26 (all in GHz). This report discusses the method of collecting the data, system measurement accuracy, the test data compiled, and diagostics and isolation of causes of pattern results. The technique of using near-field phase for measuring surface mechanical tolerances is included. Detailed far field antenna patterns and their implications are provided for all tests conducted. Author

N87-22345*# Army Missile Lab., Redstone Arsenal, Ala.
TACTICAL MISSILE TURBULENCE PROBLEMS
Richard E. Dickson *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 47-51 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 16D

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N87-21988# Regis Coll., Weston, Mass.
CHARACTERISTICS OF THE THERMAL PLASMA MONITOR (SSIES) FOR THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM (DMSP) SPACECRAFT S8 THROUGH S10 Report, for 19 Jun. 1984 - 30 Sep. 1986
M. E. Greenspan, P. B. Anderson, and J. M. Pelagatti 30 Oct. 1986 116 p Prepared in cooperation with Texas Univ., Dallas
(Contract F19628-84-C-0126)
(AD-A176924; AFGL-TR-86-0227; SR-5) Avail: NTIS HC A06/MF A01 CSCL 20I

This report provides an overview of the capabilities of the Special Sensor for Ions, Electrons, and Scintillation (SSIES), its operating modes, the data the instrument produces, and the programs used to process the data. This information is necessary to users of SSIES data, including scientists and the Air Force Geophysics Laboratory (AFGL), Regis College, the University of Texas at Dallas (UTD), and others. GRA

N87-21989 Ohio State Univ., Columbus.
VARIABLE STRUCTURE CONTROL SYSTEM MANEUVERING OF SPACECRAFT Ph.D. Thesis
Osama Abderrhman Mostafa 1986 152 p
Avail: Univ. Microfilms Order No. DA8625264

Variable structure control systems (VSCS) are a class of nonlinear systems which change the structure of the controls when a set of prescribed hypersurfaces are reached in the phase space. The theory represents a real-time implementable approach to control in contrast to algorithmic approaches, and therefore eliminates the computational burden. This dissertation applies the VSCS theory to maneuvering of a rigid spacecraft with four momentum exchange wheels and maneuvering of a flexible spacecraft. General nonlinear equations of motion are presented for the three-axes maneuver of the rigid spacecraft and for a single axis maneuver of the flexible spacecraft. Three methods are presented for designing variable structure control logics. The theory is demonstrated for set point regulation, tracking, disturbance accommodation, spin-up and robust maneuvers of specific spacecraft configurations. A practical problem in the implementation of VSCS theory is the possibility of chatter about hypersurfaces known as sliding regimes. Three methods of chatter alleviation are introduced. Specifically, the methods are: a boundary layer approach, asymptotic reaching of sliding regimes, and digital input prefiltering. Dissert. Abstr.

N87-21990# ARDAK Corp., McLean, Va.
GLOBAL LOW ORBIT MESSAGE RELAY (GLOMR) SATELLITE APPLICATIONS DEVELOPMENT PROGRAM Final Technical Report, 26 Mar. - 30 Sep. 1986
John L. Slack and Neil R. Helm 30 Sep. 1986 108 p
(Contract N00014-86-C-0330)
(AD-A177383; ARDAK-8603-01) Avail: NTIS HC A06/MF A01 CSCL 17B

The Global Low Orbit Message Relay (GLOMR) satellite is a proof of concept effort. The spacecraft was taken into orbit by the Space Shuttle, Challenger, in late October 1985 and successfully ejected into a circular orbit of 324km. The primary goals of the Applications Development program were: (1) to develop a full understanding of GLOMR's capabilities; (2) to demonstrate their potential for application to a variety of U.S. Government missions; and (3) to develop a potential user base for future low cost message relay and geopositioning satellites. A successful series of tests and demonstrations with interested user/customers was conducted, with the results meeting the goals and objectives of the program. The final success is shown by the knowledge that the user community is presently planning and budgeting for follow on spacecraft and systems. GRA

N87-21991# Severn Communications Corp., Severna Park, Md.
RADIATION SHIELDING REQUIREMENTS ON LONG-DURATION SPACE MISSIONS
John R. Letaw and Scott Clearwater 21 Jul. 1986 40 p Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract N00014-85-C-2200)
(AD-A177512; SCC-86-02) Avail: NTIS HC A03/MF A01 CSCL 22A

An analysis of radiation shielding requirements on long duration space missions is presented. The report finds the principal radiation hazards to be galactic cosmic radiation (cosmic rays) and radiation

from solar flares. Galactic cosmic radiation is a continuous source of radiation delivering a dose equivalent to the blood-forming organs varying from 20 REM/year to 50 REM/year over the 11 year solar cycle. Solar flares are randomly distributed events which are occasionally associated with lethal particle fluxes. The following recommendations are made: Investigate alternative shielding materials which may be more effective against radiation hazards discussed here; A solar flare storm shelter with a minimum of 7.5 cm aluminum shielding (or shielding of equivalent effect) is required at all times for spaceflights outside the magnetosphere. Spacecraft designed to transport people outside the magnetosphere for long durations during solar minimum must provide at least 7.5 cm aluminum shielding of all living spaces. Acceptable dose limits for the full scale exploration and industrialization of space must be studied. GRA

N87-21992# WEA, Cambridge, Mass.
COMPARISON OF WAVE-MODE COORDINATE AND PULSE SUMMATION METHODS Interim Report, 1 Sep. 1985 - 1 Dec. 1986
James H. Williams, Jr., Raymond J. Nagem, and Hubert K. Yeung 1 Dec. 1986 18 p
(Contract F49620-85-C-0148)
(AD-A177795; AFOSR-87-0280TR) Avail: NTIS HC A02/MF A01 CSCL 20K

Nondispersive pulse propagation in a simple one-dimensional lattice structure is analyzed using the pulse summation method and the wave-mode coordinate method. The results of the two methods are shown to be identical, and both methods account for the existence of equivalent paths in the lattice. Some recommendations for future research are given. GRA

N87-21993*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EQUATIONS OF MOTION OF A SPACE STATION WITH EMPHASIS ON THE EFFECTS OF THE GRAVITY GRADIENT
L. P. Tuell Mar. 1987 127 p
(NASA-TM-86588; NAS 1.15:86588) Avail: NTIS HC A07/MF A01 CSCL 22B

The derivation of the equations of motion is based upon the principle of virtual work. As developed, these equations apply only to a space vehicle whose physical model consists of a rigid central carrier supporting several flexible appendages (not interconnected), smaller rigid bodies, and point masses. Clearly evident in the equations is the respect paid to the influence of the Earth's gravity field, considerably more than has been the custom in simulating vehicle motion. The effect of unpredictable crew motion is ignored. Author

N87-21994*# Astro Aerospace Corp., Carpinteria, Calif.
STRUCTURAL CONCEPTS FOR LARGE SOLAR CONCENTRATORS Final Report
John M. Hedgepeth and Richard K. Miller Washington NASA 1987 66 p
(Contract NAS1-17536)
(NASA-CR-4075; NAS 1.26:4075) Avail: NTIS HC A04/MF A01 CSCL 10A

The Sunflower large solar concentrator, developed in the early 1970's, is a salient example of a high-efficiency concentrator. The newly emphasized needs for solar dynamic power on the Space Station and for large, lightweight thermal sources are outlined. Existing concepts for high efficiency reflector surfaces are examined with attention to accuracy needs for concentration rates of 1000 to 3000. Concepts using stiff reflector panels are deemed most likely to exhibit the long-term consistent accuracy necessary for low-orbit operation, particularly for the higher concentration ratios. Quantitative results are shown of the effects of surface errors for various concentration and focal-length diameter ratios. Cost effectiveness is discussed. Principal sources of high cost include the need for various dished panels for paraboloidal reflectors and the expense of ground testing and adjustment. A new configuration is presented addressing both problems, i.e., a deployable Pactruss backup structure with identical panels installed on the structure after deployment in space. Analytical results show that with reasonable pointing errors, this new concept is capable of concentration ratios greater than 2000. Author

N87-21995*# General Electric Co., Philadelphia, Pa. Astro-Space Div.
THE MULTI-DISCIPLINARY DESIGN STUDY. A LIFE CYCLE COST ALGORITHM
R. R. Harding, J. M. Duran, and R. R. Kauffman May 1987 107 p
(Contract NAS1-18032)
(NASA-CR-178192; NAS 1.26:178192; GE-DOC-87SDS-024) Avail: NTIS HC A06/MF A01 CSCL 22B

Life-cycle cost (LCC) is investigated as a comprehensive design criterion for two major interrelated spacecraft subsystems, Controls and Structures. A Multi-Disciplinary Design Tool (MDDT) is developed to evaluate the sensitivity of LCC to subsystem design parameters. Major costs addressed are: non-recurring; launch; ground support; maintenance; expendables; and software. Examples and results from the MDDT are described, including a structural optimization study between different truss designs; a solar array feathering trade for a minimal drag configuration during umbra; and the cost of active control of a flexible structure is compared against the cost of passive damping using visco-elastic material. Author

N87-21996*# California State Univ., Northridge.
SOVIET SPACE STATIONS AS ANALOGS, SECOND EDITION
B. J. Bluth and Martha Helppie Aug. 1986 576 p
(Grant NAGw-659)
(NASA-CR-180920; NAS 1.26:180920) Avail: NTIS HC A25/MF A01 CSCL 22B

The available literature that discusses the various aspects of the Soviet Salyut 6 and Salyut 7 space staions are examined as related to human productivity. The methodology for this analog was a search of unclassified literature. Additional information was obtained in interviews with the cosmonauts and some Soviet space personnel. Topics include: general layout and design of the spacecraft system; cosmonauts role in maintenance and repair; general layout and design of the Mir complex; effects of the environment on personnel; information and computer systems; organization systems; personality systems; and physical conditin of the cosmonaut. B.G.

N87-21974# Joint Publications Research Service, Arlington, Va.
KOVTUNENKO ON PHOBOS MISSION PROFILE, NEW SPACECRAFT DESIGN
V. Kovtunenko *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 62-65 Transl. into ENGLISH from Pravda (Moscow, USSR), 20 Oct. 1986 p 7 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N87-21997# Naval Postgraduate School, Monterey, Calif.
PARTICLE SIZING IN A SOLID PROPELLANT ROCKET MOTOR USING A LIGHT SCATTERING TECHNIQUE M.S. Thesis
Michael G. Keith Dec. 1986 59 p
(AD-A176755) Avail: NTIS HC A04/MF A01 CSCL 21B

Research was conducted to determine particle sizes across the nozzle of a small solid propellant rocket motor. Particle size was determined using light scattering techniques. The present optical components limit the lower measurable particle size to approximately three microns. During the investigation, spurious light was detected in the motor optical path. It was determined that transient pressure gradients in the motor during motor pressure rise resulted in deflection of the laser beam. Neutral burning propellant grains were shown to eliminate most of the observed difficulty. The use of a ring array in place of the linear array in the motor cavity measurement system is suggested for system improvement. GRA

N87-21998*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ARCJET STARTING RELIABILITY: A MULTISTART TEST ON HYDROGEN/NITROGEN MIXTURES
Thomas W. Haag and Frank M. Curran 1987 17 p Presented at the 19th International Electric Propulsion conference, Colorado Springs, Colo., 11-13 May 1987; sponsored by AIAA, DGLR and JSASS
(NASA-TM-89867; E-3538; NAS 1.15:89867; AIAA-87-1061) Avail: NTIS HC A02/MF A01 CSCL 21H

An arcjet starting reliability test was performed to investigate one feasibility issue in the use of arcjets onboard a satellite for north-south stationkeeping. A 1 kW arcjet was run on hydrogen/nitrogen gas mixtures simulating decomposed hydrazine. A pulse width modulated power supply with an integral high voltage starting pulser was used for arc ignition and steady-state operation. The test was performed in four phases in order to determine if starting characteristics changed as a result of long term thruster operation. More than 300 successful starts were accumulated over an operating time of 18 hrs. Overall results indicate that there is a link between starting characteristics and long term thruster operation; however, the large number of starts had no effect on steady-state performance. Author

N87-21999*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF AN OXYGEN PLASMA ON UNCOATED THIN ALUMINUM REFLECTING FILMS
Roger L. Parsons and Daniel A. Gulino (Cleveland State Univ., Ohio.) May 1987 17 p
(NASA-TM-89882; E-3564; NAS 1.15:89882) Avail: NTIS HC A02/MF A01 CSCL 10B

Thin aluminum films were considered for use as a reflective surface for solar collectors on orbiting solar dynamic power systems. A matter of concern is the durability of such reflective coatings against oxidative attack by highly reactive neutral atomic oxygen, which is the predominate chemical specie in low Earth orbit. Research to date was aimed at evaluating the protective merit of thin dielectric coatings over the aluminum or other reflective metals. However, an uncoated aluminum reflector may self-protect by virtue of the oxide formed from its exposed surface, which constitutes a physical barrier to further oxidation. This possibility was investigated, and an attempt was made to characterize the effects of atomic oxygen on thin Al films using photomicrographs, scanning electron microscopy, spectrophotometry, Auger analysis, and mass measurements. Data collected in a parallel effort is discussed for its comparative value. The results of the investigation of uncoated aluminum supported the self-protection hypothesis, and importantly, it was found that long term specular reflectance for uncoated aluminum exceeded that of Al and Ag reflectors with dielectric coatings. Author

N87-22000*# Atlantic Research Corp., Gainesville, Va. Propulsion Div.
BLOCK 2 SOLID ROCKET MOTOR (SRM) CONCEPTUAL DESIGN STUDY. VOLUME 1: APPENDICES Final Report
31 Dec. 1986 268 p
(Contract NAS8-37295)
(NASA-CR-179051; NAS 1.26:179051; TR-PL-12126-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 21H

The design studies task implements the primary objective of developing a Block II Solid Rocket Motor (SRM) design offering improved flight safety and reliability. The SRM literature was reviewed. The Preliminary Development and Validation Plan is presented. B.G.

N87-22001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE STATION ELECTRIC POWER SYSTEM REQUIREMENTS AND DESIGN
Fred Teren 1987 15 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89889; E-3577; NAS 1.15:89889; AIAA-87-9003) Avail: NTIS HC A02/MF A01 CSCL 22B

An overview of the conceptual definition and design of the space station Electric Power System (EPS) is given. Responsibilities for the design and development of the EPS are defined. The EPS requirements are listed and discussed, including average and peak power requirements, contingency requirements, and fault tolerance. The most significant Phase B trade study results are summarized, and the design selections and rationale are given. Finally, the power management and distribution system architecture is presented. Author

N87-22002# National Aerospace Lab., Tokyo (Japan).
STRUCTURAL ANALYSIS OF HIGH PRESSURE SLOTTED WALL THRUST CHAMBER. PART 1: RESULTS OF THE ELASTIC ANALYSIS
1986 25 p In JAPANESE; ENGLISH summary
(NAL-TR-897-Pt-1; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

In the development of the Japanese original booster rocket engine, designated the LE-7, four methods of fabricating the thrust chamber were investigated; the CIP (Cold Isostatic Pressing) forming method, the nickel electroforming method, the diffusion bonding method and the brazed copper powder method. The objective of the present report is to compare and evaluate these methods from the standpoint of maximum elastic stress on the thrust chamber wall. The slotted thrust chambers to be analyzed were designed according to the LE-7 engine specifications. The pressure and thermal loads on the chamber wall are taken as the boundary conditions in the following analyses. As the first step, for simplicity, axisymmetrical thin shell model analysis was conducted to evaluate the whole stress field of the chamber. Then two dimensional elastic analysis was performed at the throat plane where the maximum stress existed. These analyses proved that, of the four methods, the CIP forming method has the lowest stress field. Further analysis showed that the CIP method could be improved by inserting a thermal insulation layer between the CIP closure and the external jacket, thus decreasing the maximum stress on the chamber wall. Author

N87-22003*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COAXIAL TUBE ARRAY SPACE TRANSMISSION LINE CHARACTERIZATION

Colleen A. Switzer and David J. Bents 1987 12 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89864; E-3531; NAS 1.15:89864) Avail: NTIS HC A02/MF A01 CSCL 09C

The coaxial tube array tether/transmission line used to connect an SP-100 nuclear power system to the space station was characterized over the range of reactor-to-platform separation distances of 1 to 10 km. Characterization was done with respect to array performance, physical dimensions and masses. Using a fixed design procedure, a family of designs was generated for the same power level (300 kWe), power loss (1.5 percent), and meteoroid survival probability (99.5 percent over 10 yr). To differentiate between vacuum insulated and gas insulated lines, two different maximum values of the E field were considered: 20 kV/cm (appropriate to vacuum insulation) and 50 kV/cm (compressed SF6). Core conductor, tube, bumper, standoff, spacer and bumper support dimensions, and masses were also calculated. The results of the characterization show mainly how transmission line size and mass scale with reactor-to-platform separation distance. Author

N87-22004*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMC AND POWER QUALITY STANDARDS FOR 20-kHz POWER DISTRIBUTION
Irving G. Hansen 1987 8 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89925; E-3626; NAS 1.15:89925; AIAA-87-9355) Avail: NTIS HC A02/MF A01 CSCL 09C

The Space Station Power Distribution System has been baselined as a sinusoidal single phase, 440 VRMS system. This system has certain unique characteristics directly affecting its application. In particular, existing systematic description and control documents were modified to reflect the high operating frequency. This paper will discuss amendments made on Mil STD 704 (Electrical Power Characteristics), and Mil STD 461-B (Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference). In some cases these amendments reflect changes of several orders of magnitude. Implications and impacts of these changes are discussed. Author

23 CHEMISTRY AND MATERIALS (GENERAL)

N87-22005*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE 2.5-DIACYL-1,4-DIMETHYLBENZENES: EXAMPLES OF BISPHOTOENOL EQUIVALENTS
Michael A. Meador 1987 15 p Proposed for presentation at the 194th National Meeting of the American Chemical Society, New Orleans, La., 30 Aug. - 4 Sep. 1987
(NASA-TM-89836; E-3493; NAS 1.15:89836) Avail: NTIS HC A02/MF A01 CSCL 07A

The photochemistry of 2,5-dibenzoyl(DBX)-and 2,5-diacetyl-1,4-dimethylbenzene (DAX) has been investigated. Both compounds readily undergo photoenolization similar to 0-alkylphenyl ketones. However, unlike 0-alkylphenyl ketones DAX and DBX are each capable of undergoing two tandem photoenolizations. Photoenols derived from o-alkylphenyl ketones have been successfully trapped with Diels-Alder dienophiles to provide a convenient synthesis of substituted tetralins. Similarly, Diels-Alder trapping of DBX photoenils afforded substituted tetra- and octahydro anthracenes. Further mainpulation of these photadducts provided the corresponding anthracenes in good yield. The photochemistry of DAX and DBX will be discussed, in particular their use in the synthesis of substituted anthracenes. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials*.

N87-22006# Japan Atomic Energy Research Inst., Tokyo.
STUDIES ON RADIATION RESISTANCE OF FIBER REINFORCED PLASTIC COMPOSITES FEATURED BY EASINESS OF MANUFACTURING. 1: DEGRADATION BEHAVIOR UNDER ELECTRON IRRADIATION AT ROOM TEMPERATURE
Akira Udagawa, Miyuki Hagiwara, and Shunichi Kawanishi Jan. 1986 31 p In JAPANESE
(DE87-701014; JAERI-M-85-220) Avail: NTIS (USA Sales Only) HC A03/MF A01

Degradation behavior of fiber reinforced plastic (FRP) composite materials manufactured by conventional lamination technology was studied by measuring various mechanical properties after irradiation and observing fracture surfaces by scanning electron microscopy. When bisphenol-A type epoxy was used as matrix material, the laminated composites degraded rapidly. This fact was ascribed to poor radiation resistance of the matrix resin. The radiation resistance varied depending on types of hardeners. The dose that produced an incipient decrease in mechanical properties (threshold dose) was larger in case of carbon fiber reinforcement than glass fiber reinforcement. From the results of scanning electron microscopic observation of fractured surfaces, the superior radiation resistance in case of carbon fiber reinforcement was found due to its stable bonding interface between fiber and matrix. When BT (bismaleimide-triazine) resin was used as matrix for glass fiber reinforcement, little influence of irradiation was observed in various mechanical properties. This stability was ascribed to the stability of both the matrix resin and the bonding interface. Interlaminar shear strength reflects radiation effects on FRP. DOE

N87-22007# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
MONITORING THE CURE OF A COMPOSITE MATRIX RESIN WITH MICRODIELECTROMETRY Technical Report, Oct. 1984 - Oct. 1986
Wayne W. Bidstrup and Stephen D. Senturia 15 Nov. 1986 16 p
(Contract N00014-84-K-0274)
(AD-A177490; TR-7) Avail: NTIS HC A02/MF A01 CSCL 11D

Solvent free resin was prepared from a MY720-DDS prepreg solution by evaporation in a vacuum oven. This material was cured under vacuum by a ramp-hold-ramp to cure temperature cycle and the temperature and dielectric loss factor at 5 frequencies were measured every four minutes for the duration of the cure cycle. At selected times during the cure, small samples of the reacting mixture are removed and quenched and subsequently analyzed for Tg. At frequencies of 1 and 10 Hz, the ionic conductivity dominates the loss factor and the logarithmic derivative of the loss factor with respect to time equals the logarithmic derivative of the conductivity with respect to time. This derivative is then related to the derivative of Tg with respect to time by a WLF equation. GRA

N87-22008# Brown Univ., Providence, R. I. Div. of Engineering.
AN EXPERIMENTAL STUDY OF THE DYNAMIC MECHANICAL PROPERTIES OF AN Al-SiC(W) COMPOSITE
A. Marchand, J. Duffy, T. A. Christman, and S. Suresh Dec. 1986 41 p
(Contract N00014-85-K-0687)
(AD-A177583) Avail: NTIS HC A03/MF A01 CSCL 11D

This report presents initial results of an experimental study of the dynamic deformation and dynamic fracture behavior of a 2124-T6 aluminum alloy reinforced with 13.2 v/o Silicon carbon whiskers. Results are compared with the quasistatic behavior and with the behavior of the unreinforced 2124-T6 aluminum alloy. Two types of tests are described, one to provide static and dynamic stress-strain curves of the material in shear and the other to measure static and dynamic values of the critical stress intensity factors, K sub Ic and K sub Id, for tensile fracture. Results show that the presence of the reinforcing whiskers raises the dynamic and static flow stress of the material in shear. It is also evident that the reinforced material has considerably more ductility in shear than it has in axial deformation. As expected, the fracture response, as measured by the critical stress intensity factor K sub Ic, is not as favorable for the reinforced material as for the unreinforced. However, dynamic loading raises the value of K sub Ic for the reinforced material while producing almost no change in the unreinforced. For the reinforced material, the rate of loading is important in determining toughness, as measured by the value of K sub I, but has little influence on the stress-strain behavior in shear. GRA

N87-22009# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
SUBLAMINATE DAMAGE MECHANISMS IN COMPOSITE STRUCTURES Annual Report, 15 Apr. 1985 - 14 Apr. 1986
Lawrence W. Rehfield Jul. 1986 45 p
(Grant AF-AFOSR-0179-85)
(AD-A177593; AFOSR-86-0584TR) Avail: NTIS HC A03/MF A01 CSCL 11D

Summarized are the objectives, accomplishments and current direction of research on sublaminate damage mechanisms in composite structures. A Mode I suppression series of experiments and a companion analysis have been completed for graphite-epoxy double cracked-lap-shear specimens. The results show that a very small transverse normal force, 1-3% of the axial tensile force, is all that is needed to suppress Mode I action in interlaminar fracture. Complementary experiments on low cycle fatigue in tension and compression and on Mode I suppression in tension have been performed. The former confirm earlier static findings. The latter are also in agreement with static findings and illustrate the effectiveness of Mode I suppression technology. A practical working approach to analysis and design against delamination has been formulated. A simple fracture law is found to represent the existing data on four graphite-epoxy material systems and one glass-epoxy system created by a number of investigators on a variety of types of specimens. It has an intrinsic means of accounting for the observed high scatter of high Mode II (or Mode III), low Mode I delamination found in experiments. accounting for the observed high scatter of high Mode II (or Mode III), low Mode I delamination found in experiments. GRA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N87-22010# Oak Ridge National Lab., Tenn.
EVALUATION OF ULTRAVIOLET LIGHT/OXIDIZING AGENT AS A MEANS FOR THE DEGRADATION OF TOXIC ORGANIC CHEMICALS IN AQUEOUS SOLUTIONS
P. C. Ho 1987 19 p Presented at the International Congress on Recent Advances in the Management of Hazardous and Toxic Wastes in the Process Industries, Vienna, Austria, 8 Mar. 1987
(Contract DE-AC05-84OR-21400)
(DE87-004261; CONF-870377-2) Avail: NTIS HC A02/MF A01

Experiments have been performed to demonstrate the synergistic effect of ultraviolet light on the decomposition of toxic organic polynitro and polyhydroxy benzenes in aqueous solutions by hydrogen peroxide. These substances, which are hazardous to biota, can be degraded through photooxidation to carbon dioxide and water (and a small amount of nitric acid in the case of polynitrobenzenes). The degradation of these aromatic compounds is induced by the presence of hydroxyl radicals which are produced by the irradiation of hydrogen peroxide with ultraviolet light in water. Compounds such as 2,4-dinitrotoluene and phenol are first hydroxylated to di- and tri-hydroxybenzenes, followed by benzene-ring cleavage to produce lower-molecular-weight carboxylic acids and aldehydes via photooxidation. On further photooxidation, these carboxylic acids and aldehydes will eventually be converted to harmless carbon dioxide and water. DOE

N87-22011# California Univ., Berkeley. Dept. of Chemistry.
ELECTRONIC STRUCTURE OF PENTAVALENT PHOSPHORUS Final Report, 1 Mar. 1982 - 31 Aug. 1986
Andrew Streitwieser, Jr. Oct. 1986 210 p
(Grant AF-AFOSR-0114-82)
(AD-A177269; AFOSR-87-0024TR) Avail: NTIS HC A10/MF A01 CSCL 07D

The goal of this research is to provide increased understanding of the chemistry and reactivity of pentavalent phosphorus compounds by analysis of structures and electronic structures obtained from ab initio molecular orbital calculations. Electronic structure results were obtained by study of integrated electron density functions. To facilitate potential applications to the chemistry of known fluorophosphonate nerve gases computational emphasis was placed on oxygen and fluorine substituents and on the nature of double bonds to phosphorus. Conjugation effects in the phosphinate (hypophosphite) and metaphosphate ions have been evaluated by study of the structures and electronic structures of the oxygen compounds and isoelectronic compounds in which oxygens were replaced by methylene groups. Relative orientations of the methylene groups provide an additional structural criterion of electronic structure. Formal double bonds to phosphorus in these and other compounds are well represented as dipolar single bonds. GRA

N87-22012# Oregon State Univ., Corvallis. Dept. of Chemistry.
NONLINEAR OPTICAL SPECTROSCOPY OF MOLECULAR COMPLEXES Final Report
Joseph W. Nibler Dec. 1986 7 p
(Grant AF-AFOSR-0059-85)
(AD-A177277; AFOSR-87-0047TR) Avail: NTIS HC A02/MF A01 CSCL 07D

A Coherent Raman Loss Spectrometer was set up and used to obtain spectra of static and jet samples of CO2 at 0.003 wavenumber resolution. Coherent Raman methods were used to examine small hydrogen bonded clusters of HCN in static samples and in jet expansions. The first Raman data for a hydrogen bonded complex formed in jets was obtained, and preliminary studies of water and hydrochloric acid jet expansions have been done. CARS spectra of van der Waals complexes were taken. In the carbon dioxide dimer case the most stable conformation was found to be an offset parallel shape rather than the polar T form suggested by others previously. The first CARS detection of a low freqency intramolecular librational mode was made of the CO2 dimer. The energy distributions of nitrous oxides and carbon trifluoride photofragments of carbon fluoronitroxide were studied using CARS as a probe technique. This was the first detection of CF3 radical by Raman methods. The photodissociation of this molecule in low temperature argon matrices was also studied. GRA

N87-22013# Stanford Univ., Calif. High Temperature Gasdynamics Lab.
ADVANCED DIAGNOSTICS FOR REACTING FLOWS Final Report, 1 Oct. 1982 - 30 Sep. 1986
R. K. Hanson 6 Nov. 1986 65 p
(Contract F49620-83-K-0004)
(AD-A177342; AFOSR-87-0118TR) Avail: NTIS HC A04/MF A01 CSCL 21B

Progress is reported for the past 4 years of an interdisciplinary program to innovate modern diagnostic techniques applicable to

combustion and plasma flows. Research topics include: (1) digital flowfield imaging including 2-d and 3-d time resolved species and temperature imaging using planar laser-induced fluorescence (PLIF); (2) quantitative particle imaging in spray flames using planar Mie scattering (PMS); (3) quantitative velocity and pressure imaging using variations of PLIF; (4) advanced solid-state camera/computer systems for high-speed and high-resolution recording processing and display of flow image data; (5) fiber optic absorption/fluorescence sensors employing tunable UV, visible and IR laser sources for species measurements; (6) laser wavelength modulation spectroscopy using rapid-scanning UV, visible and IR laser sources for absorption and fluorescence measurements of species, temperature and absorption lineshapes; (7) plasma diagnostics utilizing laser-induced fluorescence and wavelength modulation techniques; and (8) laser interactions with plasmas and combustion gases. GRA

N87-22014*# National Aeronautics and Space Administration, Washington, D.C.
THE PYROLYSIS OF TOLUENE AND ETHYL BENZENE
V. G. Sokolovskaya, V. F. Samgin, R. A. Kalinenko, and N. S. Nametkin May 1987 15 p Transl. into ENGLISH from Neftekhimiya (USSR), v. 21, no. 4, 1981 p 544-551 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TT-20012; NAS 1.77:20012) Avail: NTIS HC A02/MF A01 CSCL 07D

The pyrolysis of toluene at 850 to 950 C gave mainly H2, CH4, and benzene; PhEt at 650 to 750 C gave mainly H2, CH4, styrene, benzene, and toluene. The rate constants for PhEt pyrolysis were 1000 times higher than those for toluene pyrolysis; the chain initiation rate constants differed by the same factor. The activation energy differences were 46 kJ/mole for the total reaction and 54 kJ/mole for chain initiation. The chain length was evaluated for the PhEt case (10 + or - 2). Author

N87-22015# Purdue Univ., West Lafayette, Ind. Dept. of Chemistry.
ASYNCHRONOUS OPTICAL SAMPLING FOR LASER-BASED COMBUSTION DIAGNOSTICS IN HIGH PRESSURE FLAMES Annual Progress Report, 15 Sep. 1985 - 14 Dec. 1986
Galen B. King, Normand M. Laurendeau, and Fred E. Lytle 15 Dec. 1986 31 p
(Grant AF-AFOSR-0323-84)
(AD-A177506; AFOSR-87-0253TR) Avail: NTIS HC A03/MF A01 CSCL 21B

This report describes progress on the development of a new laser based combustion diagnostic method for the quantitative measurement of both major and minor species in high pressure flames. The technique, Asynchronous Optical Sampling (ASOPS), is a state of the art improvement in picosecond pump/probe laser spectroscopy. The ASOPS signal has been observed using a solution of rhodamine B in methanol as the sample. The response of the instrument was shown to be proportional to pump power, probe power, and sample absorptance. Different frequency synthesizers and different modes of triggering were used to study their effect on signal stability. Cavity dumpers and frequency doublers have been added to the instrument to prepare for the measurement of the hydroxyl radical in atmosphere laminar flames. GRA

N87-22016# Washington State Univ., Pullman. Dept. of Pure and Applied Mathematics.
MULTIDIMENSIONAL COMBUSTION SIMULATION Final Report
John R. Cannon 1987 26 p
(Grant AF-AFOSR-0237-84)
(AD-A177548; AFOSR-87-0214TR) Avail: NTIS HC A03/MF A01 CSCL 21B

The movement of the gas-solid interface in the combustion of a solid can be reduced to a nonlinear first order hyperbolic system of partial differential equations for which the system of parabolic reaction diffusion equations act as a nonlinear source term. Some finite difference schemes are under study for implementation. Galerkin schemes will be deferred until a later date due to the complicated structure of the system. A Galerkin procedure for the one-dimensional problem of the combustion of a solid is currently under study and a computer program is being written for the study. This section consists of short statements by our faculty and graduate students on their usage of the VAX. GRA

N87-22017# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CALCULATION OF THE EQUATION OF STATE FOR SILICON M.S. Thesis
Paul L. Thee Dec. 1986 91 p
(AD-A177703; AFIT/GEP/ENP/86D-10) Avail: NTIS HC A05/MF A01 CSCL 07B

A new silicon three-body interatomic potential proposed by Tersoff has been used in a molecular dynamics computer code to determine equation of state information. Algorithms were devised and implemented to increase computational speed in the evaluation of the potential over large numbers of atoms. These involve the division of the lattice into boxes and application of the potential only to nearest neighbor atoms. The behavior of the volume, internal energy and enthalpy are presented over the temperature range of 0 to 2743 K. Over the temperature between 0 and 1000 K, the code predicts that the mass density increases, which is not observed experimentally. A ground state of unidentified structure with energy below the diamond configuration was found. It is concluded that Tersoff's silicon potential is unsuitable for use in molecular dynamics computer simulations. GRA

N87-22018*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE REACTION OF LIQUID HYDROGEN WITH LIQUID AIR IN A PRESSURE TUBE
Erich H. Karb May 1987 87 p Transl. into ENGLISH of "Versuche uber die Reaktion von Flussigem Wasserstoff mit Flussiger Luft in einem Druckrohr" rept. KFK-789 Kernforschungszentrun, Karlsruhe, West Germany, Jul. 1968 p 1-58 Original language document was announced as N69-23248 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TT-20010; NAS 1.77:20010) Avail: NTIS HC A05/MF A01 CSCL 07D

A pressure tube should protect the FR-2 reactor from the consequences of a hydrogen-air reaction, which is conceivable in the breakdown of several safety devices of the planned cold neutron source Project FR-2/16. The magnitudes and time pattern of the pressures to be expected were investigated. In the geometry used and the ignition mechanism selected, which is comparable to the strongest ignition process conceivable in the reactor, the reaction proceeds with greater probability than combustion. The combustion is possibly smaller if local limited partial detonations are superimposed. The magnitude of the pressure was determined by the masses of the reaction partners, liquid H2 and liquid air, and determines their ratio to each other. Author

N87-22019 Michigan Univ., Ann Arbor.
EFFECT OF SWIRL AND HEAT RELEASE ON FLOW FIELDS IN NON-PREMIXED TURBULENT FLAMES Ph.D. Thesis
Venkat E. Tangirala 1986 269 p
Avail: Univ. Microfilms Order No. DA8702842

The purpose is to quantify the interaction between the degree of swirl, the heat release, and the turbulent flow field in strongly swirling flames. Data were determined which show the relation between flame properties (i.e., recirculation strength, turbulence level, flame strength) and the governing parameters, such as swirl number. Measurements also identify the critical conditions when sudden changes occur, such as the onset of recirculation, fuel jet penetration through the recirculation zone, and flame blowoff. Such measurements are needed to see if the proper trends and limits can be predicted by current numerical models, as well as by future models, such as vortex or entrainment models. Laser velocimetry and Rayleigh scattering were used to map the velocity and

temperature fields in twelve flames and cold flows. Swirl number and overall fuel-air ratio were systematically varied. Several interactions between the fluid dynamics and the combustion were found. Dissert. Abstr.

N87-22020*# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
THE OXIDATION DEGRADATION OF AROMATIC COMPOUNDS Final Report, 1 Sep. 1982 - 30 Aug. 1985
Kenneth Brezinsky and Irvin Glassman May 1987 46 p
(Grant NAG3-310)
(NASA-CR-180588; NAS 1.26:180588) Avail: NTIS HC A03/MF A01 CSCL 07D

A series of experiments were conducted which focused on understanding the role that the O atom addition to aromatic rings plays in the oxidation of benzene and toluene. Flow reactor studies of the oxidation of toluene gave an indication of the amount of O atoms available during an oxidation and the degree to which the O atom adds to the ring. Flow reactor studies of the oxidation of toluene and benzene to which NO2 was added, have shown that NO2 appears to suppress the formation of O atoms and consequently reduce the amount of phenols and cresols formed by O atom addition. A high temperature pyrolysis study of phenol has confirmed that the major decomposition products are carbon monoxide and cyclopentadiene. A preliminary value for the overall decomposition rate constant was also obtained. Author

N87-22021# Universite des Sciences et Techniques de Lille (France). Lab. de Structure et Proprietes de l'Etat Solide.
INFLUENCE OF PLASTIC DEFORMATION ON THE PHOTOCONDUCTIVITY PROPERTIES OF GALLIUM ARSENIDES Ph.D. Thesis [INFLUENCE DE LA DEFORMATION PLASTIQUE SUR LES PROPRIETES DE PHOTOCONDUCTIVITE DE L'ARSENIDE DE GALLIUM]
Bertrand Gruson 1985 109 p In FRENCH
(ETN-87-99548) Avail: NTIS HC A06/MF A01

The electronic properties of semiconductor GaAs are studied to determine the optical absorption characteristics of Cr doped samples. The results do not show photoconductivity peaks that could be related to the presence of dislocations, but show that plastic deformation is the main factor to explain an increase of concentration of EL2 donors. This explains observed Hall effect variations. ESA

N87-22022# Universite des Sciences et Techniques de Lille (France). Dept. de Physique Fondamentale.
SPECTROSCOPY OF THE CuS MOLECULE. LASER EXCITATION SPECTRA AND EMISSION SPECTRA IN HOLLOW CATHODES Ph.D. Thesis [SPECTROSCOPIE DE LA MOLECULE CuS. SPECTRES D'EXCITATION LASER ET SPECTRES D'EMISSION EN CATHODE CREUSE]
Francis David 1985 195 p In FRENCH
(ETN-87-99549) Avail: NTIS HC A09/MF A01

The emission spectra, green to violet, of the CuS molecule were studied using a high resolution spectroscope. Copper sulfide was chosen because it is close to the well studied CuO molecule. An experimental continuous dye laser spectroscope was used. Unknown transitions in the blue were found. It is shown that the analysis of results is in agreement with vibration data. The examination of the lower energy bands shows that the electronic parity of the sigma state is negative. ESA

N87-22023 Paris-Sud Univ., Orsay (France). Lab. d'Infrarouge.
INTERPRETATION OF CH12D3 IN THE 6 TO 10 MICROMETER REGION. SIMULTANENOUS STUDY OF THE N3, N5 AND N6 BANDS Ph.D. Thesis [INTERPRETATION DE L'ABSORPTION DE 12CH3D DANS LA REGION 6-10 MICROMETRES. ETUDE SIMULTANEE DES BANDES N3, N5 ET N6]
Muriel Delaveau 1985 180 p In FRENCH
(ETN-87-99550) Avail: Issuing Activity

The infrared absorption spectra of the CH12D3 molecule, in particular the bands n3, n5 and n6 are studied using Fourier trasforms. A computation of the Coriolis type interactions considerably improves the interpretation of the spectra. Over 3000 lines are attributed including 1000 corresponding to forbidden transitions. The pertinence of the study to the understanding of large planetary atmospheres is explained. A complete spectra simulation in frequency and intensity is discussed. ESA

N87-22024*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PARAMETRIZATION OF ELECTRON IMPACT IONIZATION CROSS SECTIONS FOR CO, CO2, NH3 AND SO2
Santosh K. Srivastava and Hung P. Nguyen 1 Apr. 1987 84 p
Sponsored by AFOSR
(Contract NAS7-918)
(NASA-CR-180913; JPL-Pub-87-2; NAS 1.26:180913) Avail: NTIS HC A05/MF A01 CSCL 07D

The electron impact ionization and dissociative ionization cross section data of CO, CO2, CH4, NH3, and SO2, measured in the laboratory, were parameterized utilizing an empirical formula based on the Born approximation. For this purpose an chi squared minimization technique was employed which provided an excellent fit to the experimental data. Author

N87-22025# Stanford Univ., Calif. Dept. of Chemistry.
ELECTROCHEMICAL ACTIVATION OF CARBON DIOXIDE Annual Report, Oct. - 1985 - Oct. 1986
N. S. Lewis Jan. 1987 46 p
(Contract GRI-5083-260-1015)
(PB87-169850; GRI-86/0293) Avail: NTIS HC A03/MF A01 CSCL 07D

The study is concerned with the rational design of electrocatalytic systems which can effect the multi-electron transformations necessary for the reduction of CO2 to methane and methane precursors. The report details efforts to understand changes in catalyst reactivity as a result of immobilization of molecules on electrode surfaces. The local pH and solvent environment of transition metal ions immobilized in Nafion polymer films are characterized using Nafion-solution junction potentials, the pH dependence of indicator complexes, and measurements of reaction entropies for reduction of selected transition metal complexes. Author

N87-22026# Solar Turbines International, San Diego, Calif.
ULTRA-LOW NOx GAS TURBINE COMBUSTION SYSTEM Annual Report, Oct. 1985 - Sep. 1986
K. O. Smith Oct. 1986 83 p
(Contract GRI-5083-251-1000)
(PB87-169827; SR86-R-5158-35; GRI-86/0255) Avail: NTIS HC A05/MF A01 CSCL 21B

The design and initial rig testing of an ultra-low NOx gas turbine combustor primary zone are described. A lean premixed, swirl stabilized combustor was evaluated over a range of pressures up to 13.2 x 10 to the 5th power Pa(13 atm) in a test rig environment using natural gas. The program goal of reducing NOx emissions to 10 ppm (at 15% O2, dry) with coincident low CO and unburned hydrocarbon emissions was achieved at all combustor pressure levels. Appropriate combustor loading for ultra-low NOx operation was determined through emissions sampling within the primary zone. The work described represents at first step in developing an advanced gas turbine combustion system that can yield ultra-low NOx levels without the need for water injection and selective catalytic reduction. To advance the technological readiness of the lean premixed burner concept, additional effort is required in the areas of dilution zone development, combustor operating range extension, and combustion system controls. GRA

N87-22027# Argonne National Lab., Ill.
DETECTION AND CHARACTERIZATION OF POINT MUTATIONS BY TWO-DIMENSIONAL GEL ELECTROPHORESIS
C. S. Giometti and J. S. Zhang 1986 5 p Presented at the Electrophoresis '86: 5th Meeting of the International Electrophoresis Society, London, England, 9 Sep. 1986
(Contract W-31109-eng-38)
(DE87-004648; CONF-8609239-1) Avail: NTIS HC A02/MF A01

(DE87-004648; CONF-8609239-1) Avail: NTIS HC A02/MF A01

Two-dimensional gel electrophoresis (2DE) is a valuable tool for the detection of point mutations expressed as charge-shift variants in protein patterns. The ability to do subsequent 2DE mapping of peptides from the variant protein compared to the wild-type protein allows identification of peptide fragments that contain the actual amino acid substitution. The appropriate peptides can then be extracted from gels and used for amino acid sequencing. The nature of the DNA alteration that gave rise to the mutant protein may be obvious from the amino acid difference between the variant and normal protein, or the amino acid sequence could be used to synthesize gene probes to be used in DNA sequencing. The system of 2DE can thus be used to both detect a mutation and provide information on the structural changes that give rise to altered protein patterns. DOE

N87-22028# National Aerospace Lab., Tokyo (Japan).
CATALYTIC COMBUSTION FOR GAS TURBINE COMBUSTORS: REACTION CHARACTERISTICS OF MONOLITHIC Pd AND Pt/Pd CATALYSTS AT 1 ATM
Shigeru Hayashi, Hideshi Yamada, and Masaru Koshiba 1986 32 p In JAPANESE; ENGLISH summary
(NAL-TR-916; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

Studies were conducted to determine the reaction characteristics of monolithic palladium and platinum/palladium catalysts for perfectly premixed mixtures of propane/air and methane/air. The reactor is composed of five 2.5-cm-long Pd catalyst elements or four 3.8-cm-long Pt/Pd catalyst elements. Gas sampling is done between the catalysts to determine the combustion efficiency (conversion) and the levels of nitrogen oxides emissions for inlet mixture temperatures from 350 to 650 C. The maximum reactor outlet gas temperature is limited to circa 1100 C. Propane/air mixtures initiate reaction at lower temperatures than methane/air mixtures, and result in higher combustion efficiencies. The Pd catalysts are found to be more active than the Pt/Pd catalysts. The combustion efficiency data obtained at different reference velocities reveal that combustion efficiency can be correlated to the residence time. The conditions for 99% combustion efficiency are given as a function of inlet mixture temperatures, equivalence ratio, and reference velocity. Nitrogen oxides emissions are less than 1 ppm for all test conditions. Preliminary results of pressure loss measurements are described. Author

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N87-22029# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
SPECTRUM FATIGUE CRACK GROWTH RATE CHARACTERISTICS OF CAST ALUMINUM ALLOYS A201-T7 AND A357-T6 Final Report, May 1985 - Feb. 1986
Jon D. Tirpak and John J. Ruschau Dec. 1986 30 p
(AD-A176686; AFWAL-TR-86-4047) Avail: NTIS HC A03/MF A01 CSCL 11F

The spectrum fatigue crack growth characteristics of cast aluminum alloys A201-T7 and A357-T6 were evaluated and compared with wrought aluminum 7050-T76 data. For specimens tested at three different spectrum stress levels, A357-T6 consistently possessed the longest fatigue life, nearly double that of A201-T7 and 7050-T76. At the lowest maximum spectrum stress level tested 7050-T76 had a greater fatigue crack growth life than 7050-T76; at the highest maximum stress level tested 7050-T76 had a greater FCG life than A201-T7. Critical crack size of each alloy at failure varied considerably. Further analysis of the a vs. N record of each sample to obtain the crack growth rate (FCGR) vs. the corresponding stress intensity indicated that A357-T6 has the lowest crack growth rate over the range of stress intensity examined. FCGR comparisons between A201-T7 anf 7050-T76 depended on the level of stress intensity. Macrofractography revealed that the alloys had distinctively different fracture topographies. Microfractography, using scanning electron microscopy, revealed little because compressive loads obliterated features typically associated with fatigue. GRA

N87-22030# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Metallurgical Engineering and Materials Science.
FUNDAMENTAL STUDIES OF BETA PHASE DECOMPOSITION MODES IN TITANIUM ALLOYS Annual Report, 1 Oct. 1985 - 30 Sep. 1986
H. I. Aaronson, A. M. Dalley, T. Furuhara, H. J. Lee, and Y. Mou 31 Jan. 1987 29 p
(Grant AF-AFOSR-0303-84)
(AD-A177261; AFOSR-87-0007TR) Avail: NTIS HC A03/MF A01 CSCL 11F

A Transmission Electron Microscopy (TEM) investigation of bainite reaction in Titanium-X alloys was done. Particularly in a Ti-Chromium alloy, but also in other Ti-X systems, both the eutectoid alpha and the eutectoid intermetallic components of bainite have been shown to grow by means of the ledge mechanism. Unlike pearlite, the systems of ledges of the two eutectoid phases are physically independent. A theoretical treatment of the diffusional growth of two eutectoid phases has been made following an analysis due to Hillert but incorporating growth by the ledge mechanism and permitting independence of the growth of the two product phases. This analysis showed that, when the equilibrium proportions of the two precipitate phases develop, they can only grow at the same rate when h/lambda (h = ledge height and lambda = inter-ledge spacing) is the same on both. This situation does not appear to obtain in Ti-Cr bainite (when a correction is made for the non-equilibrium proportions of alpha and Ti-Cr2 formed) but does in pearlite because the ferrite and cementite phases share the same set of growth ledges. Hence a fundamental distinction has been established between the pearlite reaction and the microstructorally-defined bainite reaction. GRA

N87-22031# Japan Atomic Energy Research Inst., Tokyo.
STUDIES ON THE QUALITY OPTIMIZATION OF HASTELLOY ALLOY XR
Feb. 1986 232 p In JAPANESE
(DE87-701016; JAERI-M-86-003) Avail: NTIS (US Sales Only) HC A11/MF A01

Interim results are reported on the multi-lateral joint research program on improving quality and its assurance basis of Hastelloy alloy XR with special emphasis placed on the effect of a small amount of boron in the alloy. In the first phase work the exploratory examination on the optimum boron content was made. The results of the tests on several key items yield the optimum range of boron content as 40 to 70 ppm. The second phase work was organized to perform qualification tests on an industrial scale heat, which was specified its boron content (40 ppm) based on the previous phase work. The tests included weldability, tensile and creep-rupture properties, post aging toughness and corrosion and carburization resistance on different type of products. Tests are in progress, in which considerable difference in the degree of improvement was noted between plate and tube. DOE

N87-22032# Japan Atomic Energy Research Inst., Tokyo.
CARBURIZATION BEHAVIOUR OF HIGH TEMPERATURE ALLOYS IN CARBURIZING ENVIRONMENT
Mar. 1986 27 p
(DE87-701053; JAERI-M-86-053) Avail: NTIS (US Sales Only) HC A03/MF A01

In studying the carburization behavior of high temperature alloys, carburization tests in heavy carburizing environment were undertaken on several potential candidate alloys for uses in HTR system. The alloys tested were R 4286 developed by ERANS (Engineering Research Association of Nuclear Steel-making) program, Ni-18.5% Cr-21.5% W as identified F alloy, Hastelloy XR and Hastelloy XR-II, and the test environment conditions employed were (Ar + 10% CH/sub 4/) gas at 800, 850, 900 and 950 C for up to 100 hours. It is shown that when no protective

surface oxide layer is formed, the carburization kinetics follows a parabolic rate law, and the alloying additions of Al and Ti have a beneficial effect in dry environment (very low oxidizing) on the carburization resistance due to the formation of Al-Ti-based oxide and without formation of Cr-based oxide. In the comparison of the carburization resistance of the alloys tested, R 4286 containing 2% Al and 2.5% Ti exhibits the best resistance due to the formation of the protective Al-Ti-based oxide and the F alloy shows a moderate resistance, while Hastelloys XR and XR-11 are found to have the lowest resistance. DOE

N87-22033*# Alabama Agricultural and Mechanical Coll., Normal. Dept. of Physics.
A STUDY OF MICROSTRUCTURAL CHARACTERISTICS OF Ni-BASED SUPERALLOYS AT HIGH TEMPERATURES Semiannual Technical Report
R. B. Lal and M. D. Aggarwal May 1987 66 p
(Grant NAG8-076)
(NASA-CR-180594; NAS 1.26:180594; AAMU-NAG-001) Avail: NTIS HC A04/MF A01 CSCL 11F

The microstructure of the Ni-based superalloy MAR-M246 (Hf) which is used in manufacturing the components of the Space Shuttle Main Engine was investigated. In the first year, the superalloy will be studied using optical photomicrographs and the differential thermal analysis. During this period, the existing experimental equipment like cutting, grinding/polishing machines, metallurgical microscope will be used to but/polish and take the photomicrographs. At present, only a 35 mm camera attachment with the olympus inverted metallurgical microscope is being used. Due to this, there was considerable delay in processing photographs. A Perkin-Elmer Differential Thermal Analyzer (DTA-1700) was ordered and finally installed on April 28, 1987. Preliminary test runs were made on silver as well as MAR-M246 (Hf). Author

N87-22034*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPLICATION OF SINGLE CRYSTAL SUPERALLOYS FOR EARTH-TO-ORBIT PROPULSION SYSTEMS
R. L. Dreshfield and R. A. Parr (National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.) 1987 15 p Proposed for presentation at the 23rd Joint Propulsion Conference, San Diego, Calif., 29 Jun. - 2 Jul. 1987; sponsored by AIAA, SAE, ASME and ASEE
(NASA-TM-89877; E-3556; NAS 1.15:89877; AIAA-87-1976) Avail: NTIS HC A02/MF A01 CSCL 11F

Single crystal superalloys were first identified as potentially useful engineering materials for aircraft gas turbine engines in the mid-1960's. Although they were not introduced into service as turbine blades in commercial aircraft engines until the early 1980's, they have subsequently accumulated tens of millions of flight hours in revenue producing service. The space shuttle main engine (SSME) and potential advanced earth-to-orbit propulsion systems impose severe conditions on turbopump turbine blades which for some potential failure modes are more severe than in aircraft gas turbines. Research activities which are directed at evaluating the potential for single crystal superalloys for application as turbopump turbine blades in the SSME and advanced rocket engines are discussed. The mechanical properties of these alloys are summarized and the effects of hydrogen are noted. The use of high gradient directional solidification and hot isostatic pressing to improve fatigue properties is also addressed. Author

N87-22035# Auburn Univ., Ala. Dept. of Mechanical Engineering.
ORDERED CARBON-METAL ALLOYS FOR EXTRATERRESTRIAL POWER SYSTEMS Final Progress Report, Jun. 1984 - Dec. 1986
Bryan A. Chin, N. H. Madsen, K. C. Yeh, P. F. Gills, and Jie Chen 8 Dec. 1986 278 p
(Grant AF-AFOSR-0168-83)
(AD-A177376; Rept-862BC2ETPS; AFOSR-87-0101TR) Avail: NTIS HC A13/MF A01 CSCL 11F

The objective of this research is to investigate a new class of material composed of 30-60 atomic percent (Carbon-Titanium) for ultrahigh temperature applications in space power systems. The alloy system under investigation exhibits melting temperatures in excess of 2500 degrees C and from long range ordered structures which are expected to yield materials with exceptional high temperature strength and resistance to environmental degradation. GRA

N87-22036# Massachusetts Inst. of Tech., Cambridge.
MECHANISMS OF TRANSFORMATION TOUGHENING Final Report
G. B. Olson, D. M. Parks, and I. W. Chen 28 Feb. 1987 39 p
(Contract DE-FG02-84ER-45154)
(DE87-006816; DOE/ER-45154/1) Avail: NTIS MF A01

Mechanisms of transformation toughening in ductile solids are investigated by: (1) detailed observations of crack-tip processes, and (2) numerical modelling with experimentally-derived constitutive relations. Two series of model alloy steels have been developed for convenient study of transformation toughening at room temperature and for detailed study of constitutive behavior. Constitutive relations based on strain-induced transformation kinetics are being refined for these homogeneous austenitic alloys and extended to dispersed-phase systems. Using alloy composition to vary phase stability, processes of shear-instability-controlled fracture at sectioned crack tips are observed with and without transformation plasticity interactions. Quantitative constitutive relations developed for the experimental alloys are applied to crack-tip and notch fields to study transformation plasticity interaction with various models of microvoid-softening-induced shear localization. A final stage of the proposed research involves generalization of derived concepts to related phenomena in other ductile solids. DOE

N87-22037# Los Alamos National Lab., N. Mex.
EVALUATION OF THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF A Ti-6Al-4V SHELL
P. S. Follansbee, G. T. Gray, III, and M. F. Lopez Apr. 1987 17 p
(Contract W-7405-eng-36)
(DE87-007710; LA-10950-MS) Avail: NTIS HC A02/MF A01

We describe work performed to evaluate the mechanical properties of a Ti-6Al-4V shell. Of particular interest were the mechanical properties at strain rates up to approximately 10/s. Two tasks were undertaken during this project. The first was a fundamental study of the deformation mechanisms in Ti-6Al-4V to identify the underlying rate controlling processes. The second task was a thorough evaluation of an actual Ti-6Al-4V shell, with the intent to characterize the microstructure and mechanical properties of a manufactured component. This latter task is the focus of this report. A simple constitutive law is proposed to describe the strain hardening and strain-rate sensitivity of the shell material. A much more extensive and physically based formulation for the constitutive behavior is presented in the Appendix. DOE

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N87-22038# Cincinnati Univ., Ohio. Dept. of Materials Science and Engineering.
STRUCTURE AND PROPERTIES OF POLYMER INTERPHASES Annual Report, 1 Jul. 1985 - 30 Jun. 1986
F. J. Boerio 1 Dec. 1986 46 p
(Contract N00014-85-K-0459)
(AD-A176325; AR-1) Avail: NTIS HC A03/MF A01 CSCL 11A

The structure of polymer interphases in adhesive joints has been determined using X-ray photoelectron spectroscopy and

internal reflection infrared spectroscopy. When an epoxy adhesive was cured against 2024 aluminum using a polyamine curing agent, the amount of crosslinking in the adhesive adjacent to the oxide was significantly higher than in the bulk adhesive due to catalysis of the curing reaction by hydroxyl groups present on the oxidized surface of the aluminum and to protonation of the amino groups on the polyamine curing agent. When an epoxy adhesive was cured against titanium that had been pre-treated with dilute aqueous solution of gamma aminopropyltriethoxysilane(gamma-APS), the structure of the interphase depended on the curing agent. With tertiary amine salt curing agents, there was little interdiffusion of the silane and the epoxy and the interphase consisted mostly of a siloxane polymer. When anhydride curing agents were used, there was considerable interdiffusion of the silane and the epoxy and the silane reacted with the curing agent to form an interphase that contained amide and a few imide groups. Metal substrates were found to have a significant effect on the structure of the silane primer. When gamma-APS films were deposited on iron or titanium and then dried at 110 C, the silane polymerized to form siloxane polymers. The amino groups in the siloxane polymers absorbed carbon dioxide and water from the atmosphere to form amine bicarbonates salts. GRA

N87-22039# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
SYNTHETIC METALS FROM INTERCALATED GRAPHITE Semiannual Report, 1 Oct. 1985 - 31 Mar. 19 86
M. S. Dresselhaus and G. Dresselhaus 9 Apr. 1986 12 p
(Contract F49620-83-C-0011)
(AD-A177214; AFOSR-87-0106TR; SAR-3) Avail: NTIS HC A02/MF A01 CSCL 11F

During the six month period October 1, 1985 to March 31, 1986, efforts on the Program, Synthetic Metals from Intercalated Graphite, were largely focused on studies of magnetic graphite intercalation compounds. Magnetoresistance measurements of the magnetic field-induced phase transitions at high magnetic fields in the model donor compound Europium intercalation compound were interpreted using a Monte Carlo simulation to gain insight into magnetic interactions between the graphite pi electrons and the intercalant f-electrons. GRA

N87-22040# Japan Atomic Energy Research Inst., Tokyo.
DIFFUSION AND SOLUBILITY OF OXYGEN IN GAMMA-RAY IRRADIATED POLYMER INSULATION MATERIALS
Mar. 1986 68 p
(DE87-700999; JAERI-1299) Avail: NTIS (US Sales Only) HC A04/MF A01

The effects of Co-60 gamma-ray irradiation on diffusion and solubility of oxygen in polymers used for electric cable insulation materials were investigated. The polymers were polyethylene, ethylene-propylene rubber, chlorinated polyethylene, chlorosulphonated polyethylene, and chloroprene rubber. They were pure grade and several types of formulation grade. The sheets of these polymers were irradiated up to 5 - 200 Mrad under vacuum or in oxygen under pressure of 3 - 15 atm at room temperature or at 70 C. By the method of gas desorption, the diffusion coefficient (D) and solubility coefficient (S) of oxygen or argon in polymer materials were determined at various temperatures of 10 - 80 C. The D and S decreased with increase of dose, and the decrease by irradiation with oxidation was more remarkable than that by irradiation without oxidation. However, the decreases of D and S by irradiation were reduced by the formulation of polymers. The additives in formulated polymers would reduce the reactions of crosslinking or oxidation by gamma-ray irradiation irradiation. The activation energy of D was scarsely changed by irradiation with and without oxidation. DOE

N87-22041# Cornell Univ., Ithaca, N.Y.
MECHANISMS OF CARBON AND OXYGEN INCORPORATION INTO THIN METAL FILMS GROWN BY LASER PHOTOLYSIS OF CARBONYLS
N. S. Gluck, G. J. Wolga, C. E. Bartosch, Z. Ying, and W. Ho 1986 27 p
(Contracts N00014-81-K-0505; N00014-85-G-0015)
(AD-A177358) Avail: NTIS HC A03/MF A01 CSCL 07A

Metal film growth by low power UV-laser photolysis of metal carbonyls is discussed. Small-area Molybdenum, Tungsten, and Chromium films were grown on Silicon substrates by photolysis in a background pressure of 0.1-0.2 Torr of the carbonyl. The different metals exhibited vastly different deposit morphologies. Elemental depth profiling by Auger electron spectroscopy (AES) revealed the presence of large amounts of carbon and oxygen in the films. Ultrahigh vacuum studies of the interaction of 257 and 514 nm radiation with multilayer coverages of Mo(CO)6 and W(CO)6 adsorbed on Si(111)7x7 using high resolution electron energy loss spectroscopy (HREELS), laser induced desorption (LID), and AES were performed to clarify the mechanisms of adsorbed metal carbonyl film growth. GRA

N87-22042# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
THE PRECERAMIC POLYMER ROUTE TO SILICON-CONTAINING CERAMICS
Dietmar Seyferth and Yuan-Fu Yu 23 Feb. 1987 22 p
(Contract N00014-82-K-0322)
(AD-A177371; TR-19) Avail: NTIS HC A02/MF A01 CSCL 11B

Silicon-containing ceramics include the oxide materials, silica and the silicates; the binary compounds of silicon with non-metals, principally silicon carbide and silicon nitride, silicon oxynitride and the sialons; main group and transition metal silicides, and, finally, elemental silicon itself. While there is vigorous research activity throughout the world on the preparation of all of these classes of solid silicon compounds by the newer preparative techniques, in this report we will focus our attention on silicon carbide and silicon nitride. Silicon carbide, SiC (1) and silicon nitride, Si3N4 (2), have been known for some time. Their properties (Tables 1 and 2), especially their high thermal and chemical stability, their hardness, their strength, as well as other properties have led to useful applications for both of these materials. Silicon carbide has been an article of commerce since the development of the Acheson process for its manufacture just before the turn of the century, but silicon nitride is a relative newcomer as far as commercial utilization goes (3). Its modern applications include: gas turbine parts, rocket housings, electric insulators, thermocouple tubes, high temperature bearings, laser nozzles, and thin film in microelectronics. GRA

N87-22043# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
MICROFABRICATED STRUCTURES FOR THE MEASUREMENT OF ADHESION AND MECHANICAL PROPERTIES OF POLYMER FILMS
Mark G. Allen and Stephen D. Senturia 15 Nov. 1986 7 p
(Contract N00014-84-K-0274)
(AD-A177534; TR-9) Avail: NTIS HC A02/MF A01 CSCL 11A

Microfabricated test structures for the in-situ measurement of adhesion of thin films have been described. Young's modulus and residual tensile stress are determined from pre-peel measurement of the load-deflection behavior of suspended membranes. On systems of weak adhesion, a blister test using suspended membranes has been carried out. For systems of good adhesion, an island test structure has been developed allowing even thin films to be tested. Mechanical models for all three structures are described. GRA

N87-22044# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
DIELECTRIC ANALYSIS OF THE CURE OF THERMOSETTING EPOXY/AMINE SYSTEMS Technical Report, Feb. - Oct. 1986
Sue A. Bidstrup, Norman F. Sheppard, Jr., and Stephen D. Senturia 15 Nov. 1986 15 p
(Contract N00014-84-K-0274)
(AD-A177569; TR-8) Avail: NTIS HC A02/MF A01 CSCL 11I

A low molecular weight epoxy resin was cured isothermally with an aromatic amine hardener, and the ionic conductivity was measured as a function of frequency, reaction time and cure temperature. At specific stages in the cure small samples from the reacting mixture were quenched, and then analyzed for the glass transition temperature and epoxy group conversion by differential scanning calorimetry. In this manner changes in ionic conductivity could be directly correlated with the build-up of network structure during polymerization. The conductivity was modeled as a function of the cure temperature and the cure-dependent glass transition temperature using a Williams-Landel-Ferry (WLF) relation. The behavior of the conductivity for an isothermal curing system was found to be consistent with the WLF behavior of a set of neat epoxy resins of various Tg, but with changing temperature. An empirical DiBenedetto relation was used to correlate changes in epoxy conversion with the glass transition temperature. Combining the DiBenedetto model with the WLF relation for conductivity, the ioni conductivity can be predicted as a function of the epoxy group conversion. GRA

N87-22045# Office of Naval Research, London (England).
NATO WORKSHOP ON THE DESIGN, ACTIVATION AND TRANSFORMATION OF ORGANOMETALLICS INTO COMMON AND EXOTIC MATERIALS
Robert W. Vest 2 Feb. 1987 18 p Workshop held in Cap d'Agde, France, 1-5 Sep. 1986
(AD-A177596; ONRL-7-005-C) Avail: NTIS HC A02/MF A01 CSCL 11B

The objective of this workshop was to identify the scope and potential rewards of research efforts in the development of methods of transforming organometallic compounds into useful materials. This report covers the presentations in chemical vapor deposition, sol-gel processing, and preceramic polymers. GRA

N87-22046# Johns Hopkins Univ., Baltimore, Md. Dept. of Chemical Engineering.
SEPARATING POLYMER SOLUTIONS WITH SUPERCRITICAL FLUIDS. 2: POLYSTYRENE-TOLUENE-ETHANE
A. J. Seckner, A. K. McClellan, and Mark A. McHugh 24 Feb. 1987 32 p
(Contract N00014-85-K-0709)
(AD-A177646; TR-4) Avail: NTIS HC A03/MF A01 CSCL 07C

The effect of supercritical ethane on the high-pressure phase behavior of the polystyrene-toluene system is experimentally investigated. Adding 17.8 wt-% ethane to the polystrene-toluene solution reduces the temperature of the lower critical solution temperature (LCST) curve by 162 C, 22.5 wt-% lowers the temperature of the LCST curve by 231 C, and with 24.9 wt-% the LCST curve is shifted to such low temperatures that it merges with the upper critical solution temperature (UCST) curve. In practice this means that polymer solutions can be separated at lower temperatures where thermal degradation of the polymer is less. Also, greater than 99 wt-% of the polystyrene is recovered in the polymer-rich phase after the solution phase splits. Preliminary results are reported on the effects of shearing (i.e., mixing) and polymer entanglement/disentanglement times on the location of LCST and UCST curves in pressure-temperature (P-T) space. Patterson's corresponding states treatment is used to model the LCST data. GRA

N87-22047# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF OBTAINING FIREPROOF POLYACRYLONITRILE FIBER OR FABRIC MADE FROM IT
V. Ye. Kotina, A. A. Konkin, and R. M. Kosova 19 Feb. 1987 6 p Transl. into ENGLISH from Russian Patent No. 138,324 (17 Nov. 1966)
(AD-A177794; FTD-ID(RS)T-0142-87) Avail: NTIS HC A02/MF A01 CSCL 07A

A method is known for obtaining fireproof polyacrylonitrile fiber by means of heating up to 200 C. However, the fiber which is obtained has low strength characteristics. A method is being proposed for obtaining fireproof polyacrylonitrile fiber or fabric made out of it. In this method the polyacrylonitrile fiber is subjected to gradual heat treatment, being heated initially at 200 C for 25-30 h. Then the temperature is raised to 300 C at a rate of 1.5-2.0 per minute. After a temperature of 300 C is reached the temperature is raised to 400-475 in the course of 15-25 min. In this case, a fireproof material with satisfactory mechanical properties is obtained. The processed polyacrylonitrile fabric does not catch fire in the flame of a burner and has the following strength characteristics: weight of 1 sq meter - 200 g; strength on base 38-45 rkm abbreviation not verified, on the weft - 30-35 rkm; elongation on base and on the weft - 4-5%. GRA

N87-22048*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMO-OXIDATIVELY STABLE CONDENSATION POLYMIDES CONTAINING 1,1,1-TRIARYL-2,2,2-TRIFLUROETHANE DIAN HYDRIDE AND DIAMINE MONOMERS
William B. Alston and Roy F. Gratz (Mary Washington Coll., Fredricksburg, Va.) 1987 5 p Proposed for presentation at the Symposium on Recent Advances in Polyimides and Other High Performance Polymers, 13-16 Jul. 1987, Reno, Nev.; sponsored by the American Chemical Society
(NASA-TM-89875; E-3551; NAS 1.15:89875; AVSCOM-TR-87-C-7) Avail: NTIS HC A02/MF A01 CSCL 11B

Nine new condensation polyimides containing the trifluorophenylethylidene linkage were synthesized by the amic-acid route. Several other polyimides, including some with the hexafluoroisopropylidene linkage, were also prepared as controls. Amic-acid solutions were characterized by determining their inherent viscosities prior to thermal conversion into polyimide films. Glass transition temperatures (T sug g), thermogravimetric analysis (TGA), and isothermal weight loss data were obtained for the films. The films were pulverized into molding powders which, in turn, were thermally processed under pressure into neat resin discs. The discs were also characterized by T sub gs and 316 C and 371 C isothermal weight losses. The film study identified two new polyimides with T sub gs greater that 371 C and two new polyimides with low rates of weight loss. The resin discs exhibited the same overall trends in T sub g and weight loss as the respective films, however the weight loss per unit surface area was always greater, presumably due to voids or to mechanical degradation induced during preparation of the molding powders. Author

N87-22049# Rochester Univ., N. Y. Lab. for Laser Energetics.
PRACTICAL MEASUREMENTS OF ADHESION AND STRAIN FOR IMPROVED OPTICAL COATINGS
S. D. Jacobs, J. E. Hayden, and A. L. Hrycin 1986 13 p Presented at the 30the SPIE Technical Symposium on Optics and Optoelectronic Engineering, San Diego, Calif., 17 Aug. 1986 Prepared in cooperation with Eastman Kodak Co., Rochester, N.Y.
(Contract DE-FC08-85DP-40200)
(DE87-005918; DOE/DP-40200/35; CONF-860880-48) Avail: NTIS HC A02

Adhesion and strain are two important physical properties which determine the success or failure of thin-film coatings in optical applications. In this paper we describe the design and operation of a dynamically loaded scratch tester for making measurements of relative adhesive strength, and a modulated transmission ellipsometer for measuring total and internal strain. Numerous examples for coating/substrate systems of interest to optical applications are given. DOE

N87-22050# Washington Univ., Seattle. Dept. of Chemistry.
FUNDAMENTAL STUDIES OF ELASTOMERS Progress Report, 15 Jun. 1984 - 14 Jun. 1987
B. E. Eichinger 15 Feb. 1987 7 p
(Contract DE-FG06-84ER-45123)
(DE87-007119; DOE/ER-45123/3) Avail: NTIS HC A02/MF A01

Work reported includes: synthesis of metal-chelate elastomers, derivation of diene polymers, preparation of coordination polymers, electric conductivity, computer simulations, and theoretical shapes. DOE

N87-22051# National Aeronautical Lab., Bangalore (India). Materials Science Div.
THE USE OF ENERGY DISPERSIVE METHOD WITH TUNGSTEN CARBIDE OPPOSED ANVIL HIGH PRESSURE SET UP
A. K. Singh and S. Usha Devi Jul. 1986 24 p
(NAL-TM-MT-8610) Avail: NTIS HC A02/MF A01

The use of an energy dispersive method has been discussed to record the X-ray diffraction data from a tungsten carbide opposed anvil high pressure set up. It is pointed out that a proper collimation of the incident and the diffracted beams can eliminate the scattering from the gasket materials. This results in an appreciable improvement in the quality of the recorded diffraction data. The choice of the various parameters has been discussed. The data on sodium chloride are presented in support of this analysis. Author

N87-22052# National Aerospace Lab., Tokyo (Japan).
TENSILE STRENGTH OF ENGINEERING CERAMICS
Yoshiaki Fujisawa, Katsutoshi Matusue, and Kitao Takahara 1986 11 p In JAPANESE; ENGLISH summary
(NAL-TR-900; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Uniaxial tensile strength tests of engineering ceramics were carried out in air at temperatures ranging from room temperature up to 1600 C. The ceramic materials chosen for tensile tests were selected as representing existing and developing silicon nitride, silicon carbide and partially stabilized zirconia materials technology, suitable for gas turbine applications. The tensile strength of silicon nitride rapidly decreased at temperatures above 800 to approx. 1000 C. When the temperature increased to as high as 1300 C, the strength decreased to about 10 percent of room temperature strength. On the other hand, the strength of silicon carbide did not change appreciably with temperature. The strength of zirconia decreased with increasing temperatures. At 1000 C the strength was reduced to 8 percent of room temperature strength. Observations of the fracture origin and of the crack propagation on the fracture surfaces are discussed. Author

N87-22053*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADHESIVE EVALUATION OF NEW POLYIMIDES
Terry L. StClair and Donald J. Progar Apr. 1987 6 p
(NASA-TM-89140; NAS 1.15:89140) Avail: NTIS HC A02/MF A01 CSCL 11B

During the past 10 to 15 years, the Materials Division at NASA Langley Research Center (LaRC) has developed several novel high temperature polyimide adhesives for anticipated needs of the aerospace industry. These developments have resulted from fundamental studies of structure-property relationships in polyimides. Recent research at LaRC has involved the synthesis and evaluation of copolyimides which incorporate both flexibilizing bridging groups and meta-linked benzene rings. The purpose was to develop systems based on low cost, readily available monomers. Two of these copolyimides evaluated as adhesives for bonding titanium alloy, Ti(6Al-4V), are identified as LARC-STPI and STPI-LARC-2. Lap shear strength (LSS) measurements were used to determine the strength and durability of the adhesive materials. LSS results are presented for LARC-TPI and LARC-STPI lap shear specimens thermally exposed in air at 232 C for up to 5000 hrs. LARC-TPI was shown to perform better than the copolymer LARC-STPI which exhibited poor thermooxidative performance possibly due to the amines used which would tend to oxidize easier than the benzophenone system in LARC-TPI. Author

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N87-22054# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
EVAPORATION OF MONODISPERSE FUEL SPRAYS IN FLOWING AIR Final Report, 1 Feb. 1983 - 1 Dec. 1986
J. E. Peters, H. Krier, K. Kim, J. E. Kirwan, and G. N. Schroering Dec. 1986 84 p
(Contract F49620-83-K-0027)
(AD-A177119; UILU-ENG-86-4012; AFOSR-87-0171TR) Avail: NTIS HC A05/MF A01 CSCL 21D

This is the Final Report of a research program dealing with liquid fuel droplet evaporation in flowing high temperature and pressurized air. A major effort was applied to the design, fabrication, and utilization of a heated air flow tunnel into which monodisperse droplets with controlled axial spacing and velocity. It was possible by photomicroscopy to measure the droplets (typically 100 microns) along individual spray streams, and then to calculate an effective evaporation rate. Both n-heptane and JP-4 fuels were injected into a hot air stream with air velocities typically exceeding 5 m/sec. The droplet evaporation data show that, for our spray, the quasi-steady isolated drop theory underestimates the evaporation rate. Air velocity and turbulence were measured by an LDV system and the recirculation zone downstream of the injector was precisely measured under cold and hot flow. These data, with the measured droplet evaporation, were sufficient in scope to allow a comparison of measurements with a comprehensive turbulent flow model. Results of that modeling work are presented and indicate that there is excellent agreement between analysis and measured flow conditions. GRA

N87-22055# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
CHEMICAL KINETICS OF NITRAMINE PROPELLANTS Interim Report, 1 Oct. 1985 - 30 Sep. 1986
Melvyn Branch Nov. 1986 18 p
(Grant AF-AFOSR-0006-84)
(AD-A177258; AFOSR-87-0120TR) Avail: NTIS HC A02/MF A01 CSCL 21H

This paper describes experimental measurements of the structure of a lean, premixed, laminar, flat flame of methane/nitrogen oxide/oxygen. The composition of stable species in the flame was measured by a cooled quartz sampling microprobe and gas chromatographic analysis. The composition of the intermediates CN, CH, NH and NH2 was measured by laser-induced fluorescence spectroscopy using an excimer laser pumped tunable dye laser system. The flame has two luminous zones, one yellow and the other violet, separated by distinct, dark nonluminous zones. The concentration of NO2 has a maximum in the yellow zone while the concentrations of CN, NH, NH2 and NO are maximum in the violet region. The CH concentration profile has two peaks with one occurring in the yellow and one in the violet luminous zone. THe first peak is thought to be due to CH4/02 reactions while the second peak is attributed to CH4/NO2 reactions. The oxidation of Ch4 is supported by the decomposition of NO2 to NO, although 02 is important in the initiation of the reaction process. GRA

N87-22056*# Astronautics Corp. of America, Madison, Wis. Astronautics Technology Center.
LUNAR SURFACE BASE PROPULSION SYSTEM STUDY. VOLUME 2: LUNAR PROPELLANT MANUAL
Ronald R. Teeter Feb. 1987 30 p
(Contract NAS9-17468)
(NASA-CR-171982; NAS 1.26:171982) Avail: NTIS HC A03/MF A01 CSCL 07D

The efficiency, capability, and evolution of a lunar base will be largely dependent on the transportation system that supports it.

Beyond the space station in low Earth orbit, a lunar-derived propellant supply could provide the most important resource for the transportation infrastructure. The key to an efficient lunar base propulsion system is the degree of lunar self-sufficiency and reasonable propulsion system performance. Lunar surface propellant production requirements must be accounted in the measurement of efficiency of the entire space transportation system. Of all chemical propellant/propulsion systems considered, hydrogen/oxygen (H/O) OTVs appear most desirable, while both H/O and aluminum/oxygen propulsion systems may be considered for the lander. Aluminized-hydrogen/oxygen and silane/oxygen propulsion systems are also promising candidates. Lunar propellant availability and processing techniques, chemical propulsion/vehicle design characteristics, and the associated performance of the total transportation infrastructure are reviewed, conceptual propulsion system designs and vehicle/basing concepts, and technology requirements are assessed. Author

N87-22057# National Aerospace Lab., Tokyo (Japan).
A STUDY OF N2O4/AMINE INJECTOR ELEMENTS. PART 1: COLD FLOW TEST
Kazuo Sato, Takayuki Sudo, Makoto Tadano, Akio Moro, and Katuaki Kosaka Feb. 1986 16 p In JAPANESE; ENGLISH summary
(NAL-TR-899-Pt-1; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

For a series of single unlike-doublet elements, cold flow, mixing tests were performed to establish the validity of the correlating parameters as indicators of mixing efficiency, and to represent the mixing characteristics of particular N2O4/Amine injector designs. Specific selections and sizing of injector element types were based on a hot-fire injector performance evaluation program. The ojective was to develop an understanding of the criteria that cause reactive stream separation (RSS), for N2O4/Amine propellants. An analytical model defining the relationship between combustion performance and the propellant spray mixing quality determined by cold-flow measurements is described. Experimental verification of the results predicted from cold-flow analysis is also described. Comparisons of the effect of mixing uniformity on the C mixing limited performance for N2O4/MMH combinations are then made. Following Rupe it was confirmed that Rupe's mixing uniformity criteria is equal to 0.5 for optimum mixing. For nonreactive stream separation, a simple relationship between mixing uniformity and miximg limited C efficiency can be used to predict actual C mixing limited performance. Author

N87-22058# National Aerospace Lab., Tokyo (Japan).
A STUDY OF N2O4/AMINE INJECTOR ELEMENTS. PART 2: COMBUSTION TEST
Tatsuo Kumagai, Akio Moro, Kazuo Kusaka, Katsuto Kisara, Noboru Abe, Masahiro Sato, Hiroshi Miyajima, and Katsuaki Kosaka Jun. 1986 23 p
(NAL-TR-907-Pt-2; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

Effects of reactive stream separation on combustion performances were experimentally investigated by conducting firing tests of a N2O4/MMH propellant in a small scale combustion chamber with unlike doublet element ejectors. Characteristic velocity efficiencies and specific impulses were parametrically obtained by varying the chamber pressure, the mixture ratio, and the length of the combustion chamber. A distinct deterioration of the performance was observed in the region of the reactive stream separation correlated by Lawver. The most significant deterioration of the performance due to reactive stream separation occurs at a mixture ratio where otherwise the performance is at a peak.
Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology.*

N87-22059*# Stanford Univ., Calif. Center for Materials Research.
PROTEIN CRYSTAL GROWTH IN LOW GRAVITY Annual Technical Report, 1 Jan. - 31 Dec. 1986
Robert S. Feigelson 22 May 1987 28 p
(Grant NAG8-489)
(NASA-CR-180602; NAS 1.26:180602) Avail: NTIS HC A03/MF A01 CSCL 20B

The solubility and growth mechanism of canavalin were studied, and the applicability of the Schlieren technique to protein crystal growth was investigated. Canavalin which may be crystallized from a basic solution by the addition of hydrogen (H+) ions was shown to have normal solubility characteristics over the range of temperatures (5 to 25 C) and pH (5 to 7.5) studied. The solubility data combined with growth rate data gathered from the seeded growth of canavalin crystals indicated that the growth mechanism at high supersaturation ratios (>1.28) is screw dislocation like. A Schlieren apparatus was constructed and flow patterns were observed in Rochelle salt (sodium potassium tartrate), lysozyme, and canavalin. The critical parameters were identified as the change in density with concentration (dp/dc) and the change in index of refraction with concentration (dn/dc). Some of these values were measured for the materials listed. Author

N87-21979# Joint Publications Research Service, Arlington, Va.
PLANS FOR INDUSTRIALIZATION OF SPACE DISCUSSED
V. S. Avduyevskiy *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 165-174 Transl. into ENGLISH from Zemlya i Vselennaya (Mowcow, USSR), no. 2, Mar. - Apr. 1986 p 2-9 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

N87-22104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACELAB 3: RESEARCH IN MICROGRAVITY
G. H. Fichtl, J. W. Cremin, C. K. Hill, O. H. Vaughan, J. S. Theon, and R. Schmitz (National Aeronautics and Space Administration, Washington, D.C.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 1-11 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

N87-22105*# EG and G Energy Measurements, Inc., Santa Ana, Calif.
SPACELAB 3 VAPOR CRYSTAL GROWTH EXPERIMENT
W. Schnepple, L. vandenBerg, N. Skinner, and C. Ortale *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 12-17 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

N87-22106*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GROWTH OF TRIGLYCINE SULFATE (TGS) CRYSTALS ABOARD SPACELAB-3
R. B. Lal, M. D. Aggarwal, A. K. Batra, R. L. Kroes, William R. Wilcox, James R. Trolinger, and Philip Cirino (Barnes Engineering Co., Stamford, Conn.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 18-26 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N87-22060 California Univ., Los Angeles.
INTEGRATED CONTROL/STRUCTURE DESIGN AND ROBUSTNESS Ph.D. Thesis
Armen Adamian 1986 198 p
Avail: Univ. Microfilms Order No. DA8702603

When a flexible structure is to be controlled actively, optimum performance is obtained by integrated, or simultaneous, design of the structure and the controller, as opposed to the common practice of designing the structure independently of control considerations and then designing a controller for a fixed structure. The primary design objective from the structural point of view usually is to minimize weight, while the control design objectives depend on the application. An important requirement for a practical control system is robustness with respect to uncertain plant parameters. Robust compensator design for fixed structures, and simultaneous control/structure design where the overall design objective combines the weight of the structure and the robustness of the closed-loop control system are discussed. For numerical optimization, robustness is represented by the sensitivity of the closed-loop eigenvalues with respect to uncertain parameters. An example illustrates the closed-loop control system with robust compensator, and two examples illustrate the optimal designs of a flexible structure along with robust compensators. Different finite element models are compared to determine models most efficient for compensator design. Dissert. Abstr.

N87-22061# Research Inst. of National Defence, Linkoeping (Sweden). Electromagnetic Environment Div.
[ACTIVITIES REPORT OF THE ELECTROMAGNETIC ENVIRONMENT DIVISION] Annual Report, 1985-1986
Mats Broems, Goesta Carlson, Mats Gunnerhead, Gunner Hedby, Goesta Kilander, Kerstin Kocken, and Lars Ladell Dec. 1986 33 p
(FOA-C-30442-3.2; ISSN-0347-3708; ETN-87-99776) Avail: NTIS HC A03/MF A01, Research Institute of National Defence, Stockholm, Sweden KR 50

Research in ionospheric radiowave propagation, radar and radio transmission, radio communication, reliability engineering, signal leakage during information transmission, and electromagnetic pulses is summarized. ESA

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N87-22062# Coast Guard, Washington, D.C. Office of Research and Development.
A LOOK AT VERY SMALL APERTURE TERMINAL SATELLITE NETWORKS Final Report
K. R. Mass Jan. 1987 18 p
(AD-A176762; USCG-D-1-87) Avail: NTIS HC A02/MF A01 CSCL 17B

One candidate technology for bypass is very small aperture terminal (VSAT) satellite communications. This technology uses small, inexpensive earth stations to replace lensed dedicated circuits. This report provides a brief overview of VSAT technology, and discusses some issues to be considered when implementing a VSAT network. Author (GRA)

N87-22063# EOS Technologies, Inc., Santa Monica, Calif.
COMMENTS ON OPTICAL TRANSFER FUNCTION TECHNIQUES AND SAR (SYNTHETIC APERTURE RADAR) IMAGING Technical Report, 1-31 Mar. 1986
Niels Jensen 31 Mar. 1986 29 p
(Contract DNA001-85-C-0103)
(AD-A177146; EOS-TR-51026-003; DNA-TR-86-111) Avail: NTIS HC A03/MF A01 CSCL 17I

Optical transfer function techniques are reviewed and applied to the problem of analyzing and specifying synthetic aperture radar (SAR) image quality. Integrated side lobe ratio is compared to similar optical measurements. The effect of pulse repetition frequency (PRF) on non-coherent transfer functions is discussed. Non-coherent and coherent transfer functions are discussed. GRA

N87-22064# Lawrence Livermore National Lab., Calif.
COMPUTATIONAL AND EXPERIMENTAL SHORT-PULSE, HIGH-POWER MICROWAVE BREAKDOWN IN A LOW-PRESSURE, AIR-FILLED RECTANGULAR WAVEGUIDE
D. J. Mayhall, J. H. Yee, R. A. Alvarez, and D. P. Byrne Nov. 1986 22 p Presented at the 3rd National Conference on High Power Microwave Technology for Defense Applications, Albuquerque, N. Mex., 1 Dec. 1986
(Contract W-7405-eng-48)
(DE87-006693; UCRL-95613; CONF-861240-13) Avail: NTIS MF A01

This paper reports on experiments conducted to verify the accuracy of computer models of atmospheric microwave attenuation. Measurements were made of 2.856 GHz, TE10 mode air breakdown in a WR-284 waveguide. The measurements were compared to one-dimensional computer calculations. Disagreements were found between measured and computed values, so a two-dimensional model was used. The two-dimensional calculations were found to agree with the experiment much better than the one-dimensional calculations. DOE

N87-22065*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RF CHARACTERIZATION OF MONOLITHIC MICROWAVE AND mm-WAVE ICs
R. R. Romanofsky, G. E. Ponchak, K. A. Shalkhauser, and K. B. Bhasin 1986 18 p Presented at the Millimeter Wave/Microwave Measurements and Standards for Miniaturized Systems, Redstone Arsenal, Ala., 6-7 Nov. 1986; sponsored by the Army Missile Command
(NASA-TM-88948; E-3259; NAS 1.15:88948) Avail: NTIS HC A02/MF A01 CSCL 20N

A number of fixturing techniques compatible with automatic network analysis are presented. The fixtures are capable of characterizing GaAs Monolithic Microwave Integrated Circuits (MMICs) at K and Ka band. Several different transitions are used to couple the RF test port to microstrip. Fixtures which provide chip level de-embedding are included. In addition, two advanced characterization techniques are assessed. Author

N87-22066# State Univ. of New York, Stony Brook. Dept. of Physics.
MILLIMETER WAVE GENERATION USING JOSEPHSON JUNCTION ARRAYS Annual Technical Report, 1 May 1985 - 30 Apr. 1986
James Lukens 20 Jun. 1986 5 p
(Grant AF-AFOSR-0205-85)
(AD-A177293; AFOSR-87-0107TR) Avail: NTIS HC A02/MF A01 CSCL 09A

During the past year, studies have been initiated to determine design parameters for distributed arrays of Josephson junctions to be used as spectrally pure sources near 100 GHz. Computer simulations have verified that proposed designs provide the required phase-locking and have determined the limits for the junction capacitance and the shunt inductance. The proper termination of the array transmission line to provide optimum phase-locking has been determined. Measurements have been made of the locking

strength between two junctions coupled via a transmission line. Results are in agreement with predictions. Work has been carried out in conjunction with NBS Boulder to test the suitability of conventional window junction fabrication technology for array sources. Several problems were revealed during these tests, including the difficulty of obtaining sufficiently low inductance shunt resistors. A technique was developed in this laboratory to fabricate lead alloy junctions with low shunt resistance and inductance which are suitable for use in array sources. GRA

N87-22067# University Coll. of North Wales, Bangor. Dept. of Physics.
AN EVALUATION AND PREPARATION OF MAGNETIC FLUID COMPOSITES FOR USE AT MILLIMETRE WAVELENGTHS Final Annual Technical Report, 1983 - 1986
J. Poppelwell, J. P. Llewellyn, and P. Davies Dec. 1986 96 p
(Contract DAJA45-83-C-0026)
(AD-A177325) Avail: NTIS HC A05/MF A01 CSCL 11B

Magnetic fluids containing magnetic particles have been combined with micron sized particles of polystyrene, copper, tin, silver and aluminum to form magnetic fluid composites. The microwave transmission properties of samples up to 1mm thick have been studied using a 3mm wavelength source and also a fully automated Fourier Transform Spectrometer. Large reductions in the transmission of the samples have been observed in fields of less than 60 Oe. The decrease in transmission arises due to metallic particle alignment in the presence of an applied field. A theoretical model for the composites has been used and the predictions are in very close agreement with experiment. The possibility of using composites as modulating devices for the 3mm wavelength range is discussed. GRA

N87-22068# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION INTO THE POTENTIAL FOR DEVELOPING A SUCCESSFUL LOG-PERIODIC HALF SQUARE ANTENNA WITH DUAL FEED M.S. Thesis
John R. Johnsen Dec. 1986 146 p
(AD-A177351; NPS62-87-003) Avail: NTIS HC A07/MF A01 CSCL 20N

The investigation of a uniformly periodic half square array antenna with dual feed was conducted to provide more information about the potential of the structure as a log-periodic antenna for use by the military. Utilizing the Numerical Electromagnetics Code (NEC), an experimental investigation of the near field characteristics and the far field radiation patterns was conducted on a modeled version of the structure to identify the necessary performance characteristics of a successful log-periodic antenna. In the near field investigation, the Brillouin diagram was used extensively to analyze performance characteristics generated by the K to Beta relationship where Beta was determined from the relative amplitude and phase of the near magnetic field created by the structure under various conditions. The far field radiation patterns were used to check the results of the Brillouin diagram and observe the presence of end and truncation effects. GRA

N87-22069# AT and T Technologies, Inc., Greensboro, N.C.
STANDARD GRAY SCALE IMAGES USERS MANUAL Final Report
Sep. 1986 24 p
(Contract DCA100-83-C-0047)
(AD-A177361; NCS-TIB-86-5) Avail: NTIS HC A02/MF A01 CSCL 14E

The CCITT is now in the process of developing standards for the transmission of gray scale, or continuous tone, monochromatic imagery as part of the Group 4 facsimile recommendations. The digital transmission of gray scale imagery is of particular importance to the government for the transmission of photographs, half-tones, maps, etc. Unfortunately, at the present time there is no standard set of gray scale images which can be used by all experimenters in the facsimile field. The purpose of this project is to develop such a set of standard images and provide them in digital form on magnetic tape or use in the development of gray scale techniques to be considered for standardization. The tapes are available from the NCS. The purpose of this manual is to describe the format and content of the image tapes in sufficient detail so that a user can make use of the information on the tape easily. Author (GRA)

N87-22070# Naval Research Lab., Washington, D. C.
SINGLE-LOOK DETECTION WITH UNKNOWN SIGNAL STRENGTHS Interim Report
Chester E. Fox, Jr. 14 Jan. 1987 32 p
(AD-A177414; NRL-9017) Avail: NTIS HC A03/MF A01 CSCL 09D

This problem concerns receiving two different waveforms that contain either noise or signal plus noise. The number of signals present is to be determined. The signal amplitudes are unknown parameters of the problem. Classical results involve estimating the unknown parameters and selecting the most likely condition. However, the total probability of error for the detection of the number of signals by using the classical procedure is high. Consequently, several alternate detection procedures are developed. All methods considered give better results than the classical method, although no single method is found to be always best. The effect of correlated noise is also investigated. GRA

N87-22071# Naval Postgraduate School, Monterey, Calif.
RADIATION CHARACTERISTICS OF SELECTED LONG WIRE ANTENNAS AS A FUNCTION OF GEOMETRY USING COMPUTER MODELING TECHNIQUES M.S. Thesis
Robert J. Gillespie, Sr. Dec. 1986 377 p
(AD-A177435) Avail: NTIS HC A17/MF A01 CSCL 09E

This thesis, sponsored by the Marine Corps Development and Education Command, Quantico, Va., examines the far field patterns of five high frequency long wire antenna configurations through the use of the Numerical Electromagnetics Code (NEC). Lossy ground and the effects of variations made to these structures are considered. The resulting far field patterns are contained in the appendix. The antenna configurations vary in length from 1.87 to 17.19 wavelengths and in their height above ground from 0.103 to 0.610 wavelengths. Variations in the antennas end-regions include: the use of a ground rod or radial screen attached to the transmitter, terminating the far end of the antenna, and varying the shape of the transmitter from a small box (radio-sized) to a large (vehicle-sized) configuration. It is concluded that both the antenna height and length determine the far field geometry, and that end-region variations also impact, though to a lesser degree, on the pattern. Tables of comparative results are provided. Author (GRA)

N87-22072# National Communications System, Washington, D.C.
STANDARD GRAY SCALE IMAGES Final Report
Sep. 1986 28 p
(AD-A177475; NCS-TIB-86-4) Avail: NTIS HC A03/MF A01 CSCL 17B

The NCS had been a leader in the development and promulgation of standardization imagery for facsimile. They have sponsored the scanning of standard CCITT documents at resolutions of 200, 240, 300, and 400 lines per inch and stored the resultant data on tape. This data has been used by many experimenters in the development of standard compression algorithms for digital facsimile. This work contributed significantly to the development of the Group 4 facsimile CCITT standard which will be of considerable value to the U.S Government. All of this past work has been directed solely at binary, black-white imagery. At the present time, there are no CCITT Recommendations that provide for the transmission of gray scale imagery via Group 4 facsimile; the CCITT is now beginning the process of developing such a standard. The digital transmission of gray scale imagery is of particular importance to the U.S. Government for the transmission of information such as ID photos and maps. Unfortunately, there is no set of standard gray scale images which can be used by all experimenters in the facsimile field to develop gray scale transmission algorithms. The purpose of a standard set of gray scale images is to make the results presented by

various experimenters in the field directly comparable without regard to differences in image content. As a result of this project, all experimenters engaged in performing studies for the CCITT regarding gray scale transmission techniques will have access to magnetic tapes containing digitized versions of the standard images. Author (GRA)

N87-22073# Stanford Univ., Calif. Applied Mathematics Group.
MATHEMATICAL PROBLEMS OF NONLINEAR WAVE PROPAGATION AND OF WAVES IN HETEROGENEOUS MEDIA Final Report, 1 Oct. 1984 - 30 Sep. 1986
Joseph B. Keller 22 Oct. 1986 14 p
(Grant AF-AFOSR-85-0007A)
(AD-A177549; AFOSR-87-0215TR) Avail: NTIS HC A02/MF A01 CSCL 12A

This is the final report of a project carried out in the Applied Mathematics Groups of the Department of Mathematics at Stanford University. Results were obtained on the stability of nonlinear waves and of solutions of nonlinear amplitude equations of the Ginzburg-Landau type. New results were obtained on solutions of the Kortweg-de Vries equation. Uniform solutions for scattering regions for Hill's equation were determined, which can be used to describe waves in periodic media. GRA

N87-22074# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DIGITAL ALGORITHM SPECIFICATION FOR THE VLSI IMPLEMENTATION OF THE ELECTROMAGNETIC FIELD OF AN ARBITRARY CURRENT SOURCE M.S. Thesis
Brian A. Hoyt Dec. 1986 119 p
(AD-A177601; AFIT/GE/ENG/86D/18) Avail: NTIS HC A06/MF A01 CSCL 20N

A digital algorithm specification has been developed for the VLSI implementation of the electromagnetic fields of an arbitrary current source. The algorithm solves for the magnetic (H) and electric (E) fields of a finite length dipole with arbitrary current sources. A mid-point summation technique is employed for the numerical solution for H and E. MACSYMA, an algebraic manipulation program was utilized to separate the H and E field equations into real and imaginary parts with rectangular vector components. A digital simulation was accomplished with a single z-directed dipole, 10 wavelengths long, for the test antenna. Numerical solutions utilizing uniform and triangular envelope current distributions were compared with the far-field solution for the test antenna at ranges of 250 and 500 wavelengths. The number of sub-elements in the mid-point summation were 50, 100, and 500. The numerical solution compared reasonably well with the far-field solution when the test antenna was segmented into 50 sub-elements. The percent difference between the numerical and far-field solutions decreased to less than 1 percent for 95 percent of the observation points when the test antennas was segmented into 500 sub-elements. The greatest differences between the numerical and far-field solutions occurred in the null regions of the radiation pattern. Author (GRA)

N87-22075# Defence Research Establishment, Ottawa. (Ontario).
A SIMULATION MODEL FOR DETECTING AIRBORNE TARGETS BY RADAR
Suzanne Y. Slinn, Mark W. Lovell, and Denise C. Miller Jun. 1986 213 p
(AD-A177607; DREO-TN-86-13) Avail: NTIS HC A10/MF A01 CSCL 17I

In support of the Space Based Radar (SBR) surveillance system technologies, a satellite simulation model has been developed. This simulation models the orbital dynamics of the multiple radar satellites, simulates the radar beam in order to study the surveillance coverage capabilities of the satellites and finally, simulates the detection of airborne targets. This report summarizes the major mathematical concepts involved in the model and provides an overview of the computer implementation of this model. GRA

N87-22076# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A COMPARISON OF COMPUTATIONAL ELECTROMAGNETIC METHODS FOR THE PREDICTION OF RADAR CROSS SECTION M.S. Thesis
Ulice J. Macias Dec. 1986 120 p
(AD-A177718; AFIT/GE/ENG/86D-13) Avail: NTIS HC A06/MF A01 CSCL 17I

The effectiveness of the various Radar Cross Section (RCS) prediction techniques was investigated. The RCS of square flat plates was analyzed using the Physical Optics approximation, the Physical Theory of Diffraction, the Geometrical Theory of Diffraction, the Uniform Theory of Diffraction, and the Moment Method or Method of Moments. The RCS predicted by the computational methods was compared to measurements performed in an anechoic RCS membership chamber. Also, the five computational methods were compared to each other in terms of plate size (in wavelengths), computer (CPU) time required for computational integrity. It was found that although the Moment Method is the most accurate RCS prediction method, it takes too much CPU time for large plates (over 2.5 wavelengths). The Uniform Theory of Diffraction, on the other hand, is accurate for large plates and takes less CPU time than the Moment Method. The Geometric Theory of Diffraction is also accurate but fails near the edge of the plate. Finally, the Physical Theory of Diffraction and the Physical Optics approximation are relatively inaccurate. GRA

N87-22077# California Univ., Los Angeles.
FREQUENCY HOPPED M-ARY FREQUENCY SHIFT KEYED (MFSK) COMMUNICATIONS USING LIST METRIC DECODING OVER JAMMING AND MULTIPLE ACCESS CHANNELS Ph.D. Thesis
Mark A. Creighton 1986 387 p
(AD-A177823) Avail: NTIS HC A17/MF A01 CSCL 17B

List metric decoding is applied to anti-jam and multiple access communication systems that employ frequency-hopped, M-ary Frequency Shift Keyed (MFSK) modulation. The performance of these systems over Guassian noise and Rayleigh fading channels is analyzed by deriving expressions for the cutoff rate parameter RO, and evaluating numerical examples. RO represents the largest reliable data rate per coded symbol that could be achieved, with a particular system and channel, by using practical coding methods. Because it is code-independent, RO is used as the basis for comparing list decoding against hard and soft decisions, without the encumbrance of analyzing specific error correcting codes. RO is then used later, along with a code-dependent function, to upper bound the bit error probability provided by a particular code. In a list decoding receiver, decisions are based on the relative magnitudes of the demodulator's energy detector outputs. GRA

N87-22078*# Notre Dame Univ., Ind. Dept. of Electrical Engineering.
ERROR CONTROL TECHNIQUES FOR SATELLITE AND SPACE COMMUNICATIONS Annual Status Report, 1 Jun. 1985 - 31 May 1987
Daniel J. Costello, Jr. Jun. 1987 79 p
(Grant NAG5-557)
(NASA-CR-180586; NAS 1.26:180586) Avail: NTIS HC A05/MF A01 CSCL 17B

The performance of bandwidth efficient trellis inner codes using two-dimensional MPSK signal constellations in a NASA concatenated coding is summarized. Work was also continued on trellis coded modulation using multi-dimensional signal sets. Achievable lower bounds on free distance trellis codes were proved and the existence of good trellis coded modulation (TCM) schemes were established for a variety of signal constellations. The performance of TCM schemes on fading channels is being investigated. Preliminary results indicate that bandwidth efficient trellis coding is feasible on such channels, but that the important design parameter is no longer the minimum free Euclidean distance. B.G.

N87-22079# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
ON THE POSSIBLE EXISTENCE OF LONGITUDINAL ELECTRIC SPACE-CHARGE WAVES
B. Lehnert Dec. 1986 20 p
(TRITA-EPP-86-16; ISSN-0348-7539; ETN-87-99789) Avail: NTIS HC A02/MF A01

An arrangement for an experimental test of the longitudinal waves in which the geometry of the generator and detector systems and the time development of the generator current are chosen such as to minimize recorded magnetic disturbances is outlined. The measurement of the space charge wave is suggested to take place during a time interval where the electric currents in the generator system are nearly constant and the corresponding magnetic field disturbances are minimized. Analysis of the choice of design parameters indicates that a test of the existence of the space charge wave is possible. The existence or nonexistence of this space charge wave could have a bearing on the existence or nonexistence of stationary electromagnetic equilibrium states in vacuo. ESA

N87-22080# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research.
ON STEADY ELECTROMAGNETIC EQUILIBRIA
B. Lehnert 31 Dec. 1986 27 p
(TRITA-EPP-87-01; ISSN-0348-7539; ETN-87-99790) Avail: NTIS HC A03/MF A01

The existence of steady electromagnetic equilibrium states predicted by an extended Lorentz invariant formulation of Maxwell's equations is analyzed. General equilibrium solutions are outlined which lead to integrated field quantities of the system, such as total charge qo, magnetic moment Mo, mass mo and angular momentum so. The quantization of moMo/qo in terms of Bohr magnetons is shown to be equivalent to the proposed resonance condition of circulating self-confined radiation. Exact equilibrium solutions were deduced in two simple cases, thereby leading to a so of the same order as that of the electron, and to a qo one order of magnitude larger than the electronic charge. A variational procedure is suggested in search for states of minimum charge, under the subsidiary quantum conditions on moMo/qo and so, i.e., by varying the profile of the electric space charge distribution. ESA

N87-22081# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Raumfahrt.
HIGH PRECISION MEASUREMENT OF TV-SAT TRANSMIT ANTENNA IN AN ANTENNA NEAR FIELD TEST FACILITY
D. Fasold, H.-D. Kress, and L. Laux 1986 16 p Presented at Mikrowellentechnologie und Optoelektronik (MIOP) '86 Fachmesse und Konferenz fuer Hoechstfrequenztechnologie, Wiesbaden, West Germany, 10-12 Jun. 1986
(MBB-UR-890/86; ETN-87-99941) Avail: NTIS HC A02/MF A01

A cylindrical near field test facility was designed and implemented for electrical testing and qualification of the TV-SAT antennas. It was used in tests at the transmission frequency range of 11.7 to 12.1 GHz, and at the RF sensor frequency of 17.3 GHz. Results prove the utility of the facility. ESA

N87-22082# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
ANALYSIS OF COMPACT ANTENNA TEST RANGE CONFIGURATIONS
E. W. M. Dudok and D. Fasold 1986 6 p Presented at JINA'86 International Symposium on Antennas, Nice, France, 4-6 Nov. 1986
(MBB-UR-892/86; ETN-87-99943) Avail: NTIS HC A02/MF A01

An antenna test center for antennas and payloads of large spacecraft was constructed. It consists of a near field and a compact test range. Results obtained during the analysis and definition phase of the compact range are described. Predicted co- and cross-polar contour plots of different compact range alternatives in the 5m x 7m quiet zone are presented. Compensation and optimization principles for the cross polarization and amplitude behavior are explained. Results show that, electrically, the front fed Cassegrain concept is the most favorable solution. However, the two cylinder parabola concept is the most attractive solution concerning the mechanical and manufacturing aspects. ESA

N87-22083# Office of Technology Assessment, Washington, D.C.
COMMERCIAL NEWSGATHERING FROM SPACE
May 1987 61 p
(OTA-TM-ISC-40; LC-87-619818) Avail: NTIS HC A04/MF A01

This memorandum does not examine the feasibility of a specific satellite system or business plan, but rather, assesses whether current government policy is appropriate to accommodate both current activities and future developments of the use of satellite images to cover newsworthy events. The mediasat term refers to a concept of a satellite system and business organization that would routinely collect news and information for media use from space. Because the mediasat concept is, for the most part, undefined, the Office of Technology Assessment (OTA) was forced to make a series of assumptions regarding fundamental issues as cost, markets, technical capability, and utility of a mediasat. Although these assumptions are critical to OTA's conclusions, they are only best guesses, based on the advice of experts in the media and in the field of remote sensing. With regard to specific issues, such as the economic viability of a mediasat or its effect on national security and foreign policy, altering these underlying assumptions could dramatically alter the conclusions reached. Author

N87-22084*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GEOSTATIONARY MICROWAVE IMAGERS DETECTION CRITERIA
J. M. Stacey 15 Dec. 1986 126 p
(Contract NAS7-918)
(NASA-CR-180912; JPL-Pub-86-52; NAS 1.26:180912) Avail: NTIS HC A07/MF A01 CSCL 20N

Geostationary orbit is investigated as a vantage point from which to sense remotely the surface features of the planet and its atmosphere, with microwave sensors. The geometrical relationships associated with geostationary altitude are developed to produce an efficient search pattern for the detection of emitting media and metal objects. Power transfer equations are derived from the roots of first principles and explain the expected values of the signal-to-clutter ratios for the detection of aircraft, ships, and buoys and for the detection of natural features where they are manifested as cold and warm eddies. The transport of microwave power is described for modeled detection where the direction of power flow is explained by the Zeroth and Second Laws of Thermodynamics. Mathematical expressions are derived that elucidate the detectability of natural emitting media and metal objects. Signal-to-clutter ratio comparisons are drawn among detectable objects that show relative detectability with a thermodynamic sensor and with a short-pulse radar. Author

N87-22085# National Telecommunications and Information Administration, Boulder, Colo. Inst. for Telecommunication Sciences.
ON-PREMISES DIGITAL COMMUNICATIONS UPGRADES WITH EMPHASIS ON FIBER OPTICS
J. A. Hull and A. G. Hanson Nov. 1986 107 p Sponsored by National Communications System
(PB87-152138; NTIA-SP-86-18; NCS-TIB-86-7) Avail: NTIS HC A06/MF A01 CSCL 17B

The Federal Telecommunications Standards Committee has established a Fiber Optics Task Group, one purpose of which is to develop guidelines for Federal agencies planning to use fiber optics in on-premises communications upgrades. The report describes the key technical elements under consideration in the Task Group. These technical elements include local area networks (LANs), digital private automatic branch exchanges (PABXs),

building-wiring distribution architecture, and the application of optical fiber waveguides in the implementation of these on-premises systems. The report develops some fundamental principles necessary to do tradeoff analyses required to make decisions regarding cost versus early technological obsolescence. Some examples of commercially available technology representing the present state of the art are included. Brief summaries of technology readiness, as presented by several key industry representatives to the Fiber Optics Task Group, are provided. GRA

N87-22086# National Telecommunications and Information Administration, Washington, D.C.
SIDELOBE GAIN CHARACTERISTICS FOR Ku-BAND EARTH-STATION ANTENNAS
J. M. Harman and R. D. Jennings Jul. 1986 46 p
(PB87-152492; NTIA-86/196) Avail: NTIS HC A03/MF A01 CSCL 20N

Measured analog data showing gain as a function of angle away from the mainbeam (maximum gain) axis have been obtained for 14 models of reflector antennas designed for operation at 11/12 GHz for reception and at 14 GHz for transmission. The antennas ranged in size from 3.5 to 11.0 m and represented equipment from four U.S. manufacturers. The analog patterns have been converted to sets of digital data pairs (gain and angle) to facilitate analysis. The data then have been analyzed following techniques recommended by the international Radio Consultative Committee (CCIR) for antennas for Earth stations in the Fixed-Satellite Service to develop statistical characterizations of gain versus angle for the sidelobe regions. The digitization and analysis techniques are discussed and statistical results are provided to show compliance with Federal Communications Commission (FCC) and CCIR recommendations. Background material from the perspectives of the CCIR, the FCC, and antenna manufacturers is also provided. GRA

N87-22087# Lawrence Livermore National Lab., Calif.
NONLINEAR COUPLING PROCESSES OF HIGH-POWER MICROWAVES INTO ENCLOSURES
J. H. Yee, G. S. Sieger, and D. J. Mayhall Feb. 1987 28 p
(Contract W-7405-eng-48)
(DE87-006875; UCID-20989) Avail: NTIS HC A03/MF A01

Numerical calculations were used to determine the effects of air breakdown on the coupling of intense microwave pulses passing through apertures. Calculations are based on a set of Maxwell equations and electron-fluid equations. Results show that the air-breakdown threshold energies in apertures have a functional dependency on pressure similar to that of air-breakdown threshold energies in the atmosphere. Variations of the transmitted energies of intense microwave pulses passing through apertures as a function of incident-field intensity and aperture size are presented. The effects of secondary emission on the air-breakdown threshold energies around apertures are also discussed. DOE

N87-22088 British Broadcasting Corp., London (England). Engineering Dept.
HDTV BROADCASTING BY SATELLITE: SOME FACTORS WHICH AFFECT THE LINK BUDGET
J. H. Stott and P. Shelswell Apr. 1987 12 p
(BBC-RD-1987/3; RA-240) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Investigated is the power required to be transmitted by a satellite broadcasting high-definition television (HDTV). A study is made of the way the various parameters which make up the link budget can be fine-tuned to give the most acceptable trade-off between satellite transmitter power and signal quality. It is concluded that, in the foreseeable future, frequencies up to at least 23 GHz may be considered for HDTV broadcasting by satellite. Author

N87-22089*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROSTRIP ANTENNA ARRAY WITH PARASITIC ELEMENTS
Kai F. Lee (Akron Univ., Ohio.), Roberto J. Acosta, and Richard Q. Lee 1987 6 p Presented at the 1987 AP-S International Symposium, Blacksburg, Va., 15-17 Jun. 1987; sponsored by IEEE
(NASA-TM-89919; E-3615; NAS 1.15:89919) Avail: NTIS HC A02/MF A01 CSCL 20N

Discussed is the design of a large microstrip antenna array in terms of subarrays consisting of one fed patch and several parasitic patches. The potential advantages of this design are discussed. Theoretical radiation patterns of a subarray in the configuration of a cross are presented. Author

N87-21888# Rome Univ. (Italy). Dept. of Electrical Engineering.
SPACE-BASED MULTIFUNCTION RADAR SYSTEMS: FUTURE TOOL FOR CIVILIAN AND MILITARY SURVEILLANCE
G. Galati and G. Losquadro (Selenia S.p.A., Rome, Italy) *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 9 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

N87-21889# Thomson-CSF, Meudon-la-Foret (France). SDC Div.
MONOPULSE SECONDARY RADAR: PRACTICAL REALIZATION AND ACHIEVEMENT. MODE S: THE RADAR OF TOMORROW
Francois Delille *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 15 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

N87-21890# Thomson-CSF, Meudon-la-Foret (France). SDC Div.
A PRACTICAL EXAMPLE OF MOVING TARGET DETECTION (MTD) PROCESSING FOR AN AIR TRAFFIC CONTROL RADAR WITH WEATHER CHANNEL
Christine Bruno *In* AGARD Efficient Conduct of Individual Flights and Air Traffic or Optimum Utilization of Modern Technology for the Overall Benefit of Civil and Military Airspace Users Dec. 1986 9 p (For primary document see N87-21881 15-04)
Avail: NTIS HC A15/MF A01

N87-21978# Joint Publications Research Service, Arlington, Va.
SATELLITE COMMUNICATIONS TODAY
Yu. B. Zubarev *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 155-164 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 3, May - Jun. 1986 p 37-43 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N87-22090# Argonne National Lab., Ill.
CAPACITY AND PEAK POWER DEGRADATION OF LEAD-ACID BATTERY UNDER SIMULATED ELECTRIC VEHICLE OPERATIONS
J. Lee, A. F. Tummillo, J. F. Miller, F. Hornstra, and C. C. Christianson 1986 6 p Presented at the 8th International Electric Vehicle Symposium, Washington, D.C., 20 Oct. 1986
(Contract W-31109-eng-38)
(DE87-004941; CONF-8610122-14) Avail: NTIS HC A02/MF A01

In a program supported by the Electric Power Research Institute, controlled laboratory tests were conducted at Argonne to evaluate the effects of selected EV application factors on the performance and life of the EV-2300 lead-acid battery. These application factors

included simulated driving profile discharges with different levels of peak power demands for vehicle acceleration, long rest times after charge or discharge, and different methods of recharging. The performance and life variations among cells and modules in a full-scale battery pack were also examined. Statistical methods were used to analyze the laboratory test data. The key factors affecting the performance and life of the battery were identified, and the rates of capacity and power degradation were quantified using multiple regression techniques. The analyses show that the most significant factors were peak power demand levels and cell location within the six-cell modules. The effects of charge method and rest times were found to be small. DOE

N87-22091# Stanford Univ., Calif. Integrated Circuits Lab.
INTERCONNECTION AND ELECTROMIGRATION SCALING THEORY
Donald S. Gardner, James D. Meindl, and Krishna Saraswat 2 Dec. 1986 30 p
(Contract MDA903-80-C-0432)
(AD-A177346) Avail: NTIS HC A03/MF A01 CSCL 11F

Interconnections will become the limit in performance and reliability at submicron dimensions. Long-distance interconnections are defined by models based on resistivity, and it is found that more than half of the interconnections will become categorized as such at 0.5 micrometers feature sizes. The resistivity of even less resistive materials, therefore, will become important. A model for analyzing the trends of material usage for interconnections and for projecting design rules is presented. Electromigration is the driving force away from the lowest resistivity silicon compatible material, namely aluminum. Replacements such as gold, however, have technological problems and the resistivity of refractory metals will be too high for a large fraction of the interconnections. Layered structures are one possible solution to the problems of electromigration. GRA

N87-22092# California Univ., San Diego, La Jolla.
RESEARCH ON MATERIALS AND COMPONENTS FOR OPTO-ELECTRONIC SIGNAL PROCESSING AND COMPUTING Annual Technical Report, 1 Dec. 1985 - 30 Nov. 1986
William S. Chang, Albert L. Keller, C. C. Sun, Timothy VanEck, and H. H. Wieder 30 Dec. 1986 28 p
(Grant AF-AFOSR-0389-84)
(AD-A177518; AFOSR-87-0268TR) Avail: NTIS HC A03/MF A01 CSCL 17H

Electro-absorption and electro-refraction properties of heterostructures and multiple quantum-well structures in III-V semiconductors were investigated for spatial modulation applications. A new device, the gate controlled photo-diode (GCPD) has been conceived and demonstrated. It has potential applications in optical signal processing. GRA

N87-22093# Brown Univ., Providence, R. I. Div. of Engineering.
CONTROL AND IDENTIFICATION OF TIME VARYING SYSTEMS Final Technical Report, 1 Jul. 1985 - 31 Aug. 1986
Allan E. Pearson 3 Oct. 1986 6 p
(Grant AF-AFOSR-0300-85)
(AD-A177567; AFOSR-87-0211TR) Avail: NTIS HC A02/MF A01 CSCL 09C

Research is summarized for the state feedback stabilization of point-delay and distributed-delay time-lag control systems via the development of a reducing transformation technique. The approach facilitates the controller design using well established delay-free methods once the unstable pole set is delineated for the time-lag system. Research is described on the dual problem of state reconstruction using input-output data and also on a tracking problem which employs integral action for the controller. Research is described in the use of a Fourier based modulating function technique for the least squares parameter identification of a class of polynomial input-output differential systems. GRA

N87-22094# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
THE POTENTIAL IMPACT OF DEVELOPMENTS IN ELECTRONIC TECHNOLOGY ON THE FUTURE CONDUCT OF AIR WARFARE, VOLUME 3
Dec. 1986 119 p Proceedings of the AGARD Avionics Panel Workshop, The Hague, Netherlands, 21-25 Oct. 1985
(AGARD-AR-232-Vol-3; ISBN-92-835-1541-2) Copyright Avail: NTIS HC A06/MF A01

Advances in microelectronics have resulted in circuit densities many orders of magnitude greater than in current usage, making possible higher speed circuitry and greater storage capacity. RF techniques are also leading to monolithic microwave integrated circuits and microstrip antennas with corresponding reductions in size and weight. In addition, rapid advances are taking place in computer architecture and software that will provide improved information processing and control. This, coupled with progress in artificial intelligence and man-machine interface, offers promise of greatly improved battle management in the cockpit. The scale of changes is such that the nature of air warfare should be significantly affected over the next twenty years. This study examined the potential of electronic technology and potential benefits such as improvements in information processing, reduction in size and weight, increased reliability and maintainability; determined the applicability of such improvements to avionics and command and control systems and such functions as navigation and guidance, communications, surveillance, cockpit engineering and electronic warfare; and examined the impact on air warfare in the time period 2000 to 2010. Author

N87-22095# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
THE D.MOS VERTICAL TRANSISTOR IN HIGH FREQUENCY POWER AMPLIFIERS Ph.D. Thesis - Toulouse Univ., France
Gilles Tardivo 1987 165 p In FRENCH; ENGLISH summary
(LAAS-87-002; ETN-87-99539) Avail: NTIS HC A08/MF A01

A nonlinear model of the V.D.MOS transistor is developed to describe its high frequency characteristics. The model is based on the physical analysis of the transistor structure and is independent of empirical measurements. A computerized simulation procedure allows the simulation as power amplifier in stable or unstable conditions. The model is applied to establish rules for the design of V.D.MOS transistors in the 500 MHz band. ESA

N87-22096# Rome Univ. (Italy). Dipt. di Fisica.
PUSH-PULL RESONANT CAPACITIVE TRANSDUCER FOR BACK-ACTION EVADING MEASUREMENT SCHEMES ON CRYOGENIC GRAVITATIONAL WAVE ANTENNAS
R. Onofrio, P. Rapagnani, and F. Ricci 7 Nov. 1986 23 p
(Nota-Interna-872; ETN-87-99765) Avail: NTIS HC A02/MF A01

The design, development, and test of a resonant capacitive transducer for gravitational wave antennas (GWA) suitable for back action evading measurement schemes are discussed. The general requirements that such a transducer must satisfy are analyzed, and the results of tests at low temperatures are given. The prototype shows a promising value of the mechanical merit factor (100,000), satisfactory geometrical balance, and good stability of the electrical and geometrical parameters. The sensitivity of a GWA equipped with improved versions of the transducer is assessed. ESA

N87-22097*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FULL-SCALE ENGINE DEMONSTRATION OF AN ADVANCED SENSOR FAILURE DETECTION, ISOLATION AND ACCOMMODATION ALGORITHM: PRELIMINARY RESULTS
Walter C. Merrill, John C. DeLaat, Steven M. Kroszkewicz, and Mahmood Abdelwahab 1987 14 p Proposed for presentation at the Guidance, Navigation and Control Conference, Monterey, Calif., 17-19 Aug. 1987; sponsored by AIAA
(NASA-TM-89880; E-3561; NAS 1.15:89880; AIAA-87-2259) Avail: NTIS HC A02/MF A01 CSCL 09C

The objective of the advanced detection, isolation, and accommodation (ADIA) program is to improve the overall demonstrated reliability of digital electronic control systems for turbine engines. For this purpose, algorithms were developed which detect, isolate, and accommodate sensor failures using analytical redundancy. Preliminary results of a full scale engine demonstration of the ADIA algorithm are presented. Minimum detectable levels of sensor failures for an F100 turbofan engine control system are determined and compared to those obtained during a previous evaluation of this algorithm using a real-time hybrid computer simulation of the engine. Author

N87-22098*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RADIATION AND TEMPERATURE EFFECTS IN GALLIUM ARESENIDE, INDIUM PHOSPHIDE AND SILICON SOLAR CELLS
I. Weinberg, C. K. Swartz, R. E. Hart, Jr., and R. L. Statler (Naval Research Lab., Washington, D. C.) 1987 14 p Presented at the 19th Photovoltaic Specialists Conference, New Orleans, La., 4-8 May 1987; sponsored by IEEE
(NASA-TM-89870; E-3546; NAS 1.15:89870) Avail: NTIS HC A02/MF A01 CSCL 09C

The effects of radiation on performance are determined for both n(+)p and p(+)n GaAs and InP cells and for silicon n(+)p cells. It is found that the radiation resistance of InP is greater than that of both GaAs and Si under 1 MeV electron irradiation. For silicon, the observed decreased radiation resistance with decreased resistivity is attributed to the presence of a radiation induced boron-oxygen defect. Comparison of radiation damage in both p(+)n and n(+)p GaAs cells yields a decreased radiation resistance for the n(+)p cell attributable to increased series resistance, decreased shunt resistance, and relatively greater losses in the cell's p-region. For InP, the n(+)p configuration is found to have greater radiation resistance than the p(+)n cell. The increased loss in this latter cell is attributed to losses in the cell's emitter region. Temperature dependency results are interpreted using a theoretical relation for dVoc/cT which predicts that increased Voc should results in decreased numerical values for dPm/dT. The predicted correlation is observed for GaAs but not for InP a result which is attributed to variations in cell processing. Author

N87-22099# Allied Bendix Aerospace, Kansas City, Mo.
BASELINE CHARACTERIZATION OF 4/3 TECHNOLOGY LARGE-SCALE INTEGRATED CIRCUIT PHOTOLITHOGRAPHY PROCESSES ON UNDERLYING OXIDE AND POLYSILICON SUBSTRATES Topical Report
J. F. Jakubczak and J. M. Sobering Feb. 1987 36 p
(Contract DE-AC04-76DP-00613)
(DE87-006580; BDX-613-3670) Avail: NTIS HC A03/MF A01

The patterning of resist images during the fabrication of integrated circuits involves many variables which were investigated through the characterization of an existing 4/3 microns technology lithography operating window for polysilicon and oxide films. The major variables affecting resist thickness are discussed and the results of variations in resist thickness are evaluated. Focus and exposure latitudes are defined at and near the present operating point. The resist develop process is evaluated and the overall resist system response is measured by defining the resist exposure threshold energy and system contrast. DOE

N87-22100# Department of Energy, Washington, D. C.
ELECTROCHEMICAL CELL WITH HIGH DISCHARGE/CHARGE RATE CAPABILITY Patent Application
L. Redey, inventor (to DOE) (Argonne National Lab., Ill.) 28 Jul. 1986 21 p
(Contract W-31109-eng-38)
(DE87-007202; US-Patent-Appl-SN-890256) Avail: NTIS HC A02/MF A01

A fully charged positive electrode composition for an electrochemical cell includes FeS2 and NiS2 in about equal molar amounts along with about 2 to 20 mole % of the reaction product Li2S. Through selection of appropriate electrolyte compositions, high power output or low operating temperatures can be obtained. The cell includes a substantially constant electrode impedance through most of its charge and discharge range. Exceptionally high discharge rates and overcharge protection are obtainable through use of the inventive electrode composition. DOE

N87-22101# Department of Energy, Washington, D. C.
ELECTROCHEMICAL CELL WITH HIGH CONDUCTIVITY GLASS ELECTROLYTE Patent Application
P. A. Nelson, I. D. Bloom, and M. F. Roche, inventors (to DOE) (Argonne National Lab., Ill.) 17 Apr. 1986 22 p
(Contract W-31109-eng-38)
(DE87-007232; US-Patent-Appl-SN-853104) Avail: NTIS HC A02/MF A01

A secondary electrochemical cell with sodium-sulfur or other molten reactants is provided with an ionically conductive glass electrolyte. The cell is contained within an electrically conductive housing with a first portion at negative potential and a second portion insulated therefrom at positive electrode potential. The glass electrolyte is formed into a plurality of elongated tubes and placed lengthwise within the housing. The positive electrode material, for instance sulfur, is sealed into the glass electrolyte tubes and is provided with an elongated axial current collector. The glass electrolyte tubes are protected by shield tubes or sheets that also define narrow annuli for wicking of the molten negative electrode material. DOE

N87-22102*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMATED MEASUREMENT OF THE BIT-ERROR RATE AS A FUNCTION OF SIGNAL-TO-NOISE RATIO FOR MICROWAVE COMMUNICATIONS SYSTEMS
Robert J. Kerczewski, Elaine S. Daugherty, and Ihor Kramarchuk 1987 14 p Presented at the 29th Automatic RF Techniques Group Conference, Las Vegas, Nev., 12-13 Jun. 1987; sponsored by IEEE
(NASA-TM-89898; E-3585; NAS 1.15:89898) Avail: NTIS HC A02/MF A01 CSCL 17B

The performance of microwave systems and components for digital data transmission can be characterized by a plot of the bit-error rate as a function of the signal to noise ratio (or E sub b/E sub o). Methods for the efficient automated measurement of bit-error rates and signal-to-noise ratios, developed at NASA Lewis Research Center, are described. Noise measurement considerations and time requirements for measurement accuracy, as well as computer control and data processing methods, are discussed. Author

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N87-22103*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACELAB 3 MISSION SCIENCE REVIEW
George H. Fichtl, ed., John S. Theon, ed. (National Aeronautics and Space Administration, Washington, D.C.), Charles K. Hill, ed., and Otha H. Vaughan, ed. Feb. 1987 98 p Symposium held in Huntsville, Ala., 4 Dec. 1985
(NASA-CP-2429; M-547; NAS 1.55:2429) Avail: NTIS HC A05/MF A01 CSCL 22A

Papers and abstracts of the presentations made at the symposium are given as the scientific report for the Spacelab 3 mission. Spacelab 3, the second flight of the National Aeronautics and Space Administration's (NASA) orbital laboratory, signified a new era of research in space. The primary objective of the mission

was to conduct applications, science, and technology experiments requiring the low-gravity environment of Earth orbit and stable vehicle attitude over an extended period (e.g., 6 days) with emphasis on materials processing. The mission was launched on April 29, 1985, aboard the Space Shuttle Challenger which landed a week later on May 6. The multidisciplinary payload included 15 investigations in five scientific fields: material science, fluid dynamics, life sciences, astrophysics, and atmospheric science. For individual titles, see N87-22104 through N87-22113.

N87-22104*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACELAB 3: RESEARCH IN MICROGRAVITY c29
G. H. Fichtl, J. W. Cremin, C. K. Hill, O. H. Vaughan, J. S. Theon, and R. Schmitz (National Aeronautics and Space Administration, Washington, D.C.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 1-11 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

The Spacelab 3 mission, which focused on research in microgravity, took place during the period April 29 through May 6, 1985. Spacelab 3 was the second flight of the National Aeronautics and Space Administration's modular Shuttle-borne research facility. An overview of the mission is presented. Preliminary scientific results from the mission were presented by investigators at a symposium held at Marshall Space Flight Center on December 4, 1985. This special issue is based on reports presented at that symposium. Author

N87-22105*# EG and G Energy Measurements, Inc., Santa Ana, Calif.
SPACELAB 3 VAPOR CRYSTAL GROWTH EXPERIMENT c29
W. Schnepple, L. vandenBerg, N. Skinner, and C. Ortale *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 12-17 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

The Space Shuttle Challenger, with Spacelab 3 as its payload, was launched into orbit April 29, 1985. The mission, number 51-B, emphasized materials processing in space, although a wide variety of experiments in other disciplines were also carried onboard. One of the materials processing experiments on this flight is described, specifically the growth of single crystals of mercuric iodide by physical vapor transport. Author

N87-22106*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
GROWTH OF TRIGLYCINE SULFATE (TGS) CRYSTALS ABOARD SPACELAB-3 c29
R. B. Lal, M. D. Aggarwal, A. K. Batra, R. L. Kroes, William R. Wilcox, James R. Trolinger, and Philip Cirino (Barnes Engineering Co., Stamford, Conn.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 18-26 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 22A

An experiment to study the growth of single crystals of triglycine sulfate (NH2CH2COOH)3 H2SO4 (TGS) was successfully carried out on the Spacelab-3 mission during April 29 to May 6, 1985. Two crystals of TGS were grown during the flight, using a specially developed cooled sting technique of solution crystal growth. For the first time in any flight experiment the growth was monitored on-board as well as on ground by video-schlieren technique. Hundreds of holograms were taken for the solution/crystal interaction during the growth process. Preliminary results indicate that the optical system worked very well and the quality of reconstructed holograms is satisfactory. The cooled sting technique was successfully demonstrated. Holographic interferograms indicate convection free, diffusion limited growth. Some of the preliminary results of crystal quality are also presented. Author

N87-22107*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DYNAMICS OF ROTATING AND OSCILLATING DROPS
T. G. Wang, E. H. Trinh, A. P. Croonquist, and D. D. Elleman *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 27-30 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 20D

The dynamics of rotation and oscillation is investigated of a freely suspended liquid drop under the influence of surface tension and positioned inside an experimental apparatus by acoustic forces in the low acceleration environment of Spacelab 3. After a drop was observed to be spherical and stably located at the center of the chamber, it was set into rotation or oscillation by acoustic torque or modulated radiation pressure force. Author

N87-22108*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A LABORATORY MODEL OF PLANETARY AND STELLAR CONVECTION c91
J. E. Hart, J. Toomre, A. E. Deane, N. E. Hurlburt, G. A. Glatzmaier, G. H. Fichtl, F. Leslie, W. W. Fowlis, and P. A. Gilman (National Center for Atmospheric Research, Boulder, Colo.) *In its* Spacelab 3 Mission Science Review Feb. 1987 p 31-41 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 03B

Experiments on thermal convection in a rotating, differentially-heated spherical shell with a radial buoyancy force were conducted in an orbiting microgravity laboratory. A variety of convective structures, or planforms, were observed depending on the magnitude of the rotation and the nature of the imposed heating distribution. The results are in agreement with numerical simulations that can be conducted at modest parameter values, and suggest possible regimes of motion in rotating planets and stars. Author

N87-22109*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH RESOLUTION INFRARED SPECTROSCOPY FROM SPACE: A PRELIMINARY REPORT ON THE RESULTS OF THE ATMOSPHERIC TRACE MOLECULE SPECTROSCOPY (ATMOS) EXPERIMENT ON SPACELAB 3 c46
Crofton B. Farmer and Odell F. Raper *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 42-62 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

The ATMOS (Atmospheric Trace Molecule Spectroscopy) experiment has the broad purpose of investigating the physical structure, chemistry, and dynamics of the upper atmosphere through the study of the distributions of the neutral minor and trace constituents and their seasonal and long-term variations. The technique used is high-resolution infrared absorption spectroscopy using the Sun as the radiation source, observing the changes in the transmission of the atmosphere as the line-of-sight from the Sun to the spacecraft penetrates the atmosphere close to the Earth's limb at sunrise and sunset. During these periods, interferograms are generated at the rate of one each second which yield, when transformed, high resolution spectra covering the 2.2 to 16 micron region of the infrared. Twenty such occultations were recorded during the Spacelab 3 flight, which have produced concentration profiles for a large number of minor and trace upper atmospheric species in both the Northern and Southern Hemispheres. Several of these species have not previously been observed in spectroscopic data. The data reduction and analysis procedures used following the flight are discussed; a number of examples of the spectra obtained are shown, and a bar graph of the species detected thus far in the analysis is given which shows the altitude ranges for which concentration profiles were retrieved. Author

N87-22110*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AURORAL IMAGES FROM SPACELAB 3 c46
Thomas J. Hallinan (Alaska Univ., Fairbanks.) and Don Lind *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 63 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

The Spacelab 3 space shuttle mission of April 29 to May 6, 1985, provided an excellent opportunity to survey the Aurora Australis from near-Earth orbit. The orbital inclination and Beta angle were such that the orbit penetrated the average auroral oval in darkness. 274 color photographs of the aurora and approximately 5 hr of black and white video recordings were obtained. The data cover 22 separate passes from seven days. On several occasions the Orbiter passed above the auroral forms. By using the orbital motion to provide the parallax, both the color photographs and the video recordings were viewed stereoscopically. The data provide the first views from outside the atmosphere of thin horizontal layers of enhanced aurora. The layers, once thought to be rare, were recorded on two out of three passes. This first observation of enhanced aurora from space eliminates concerns that the ground-based observations might have been an optical illusion caused by atmospheric refraction. Also, for the first time, vertically thin layers were observed in diffuse aurora. This is a measurement that is possible only from space ideally in near-Earth orbit. Author

N87-22111*# Tata Inst. of Fundamental Research, Bombay (India).
IONS (ANURADHA): IONIZATION STATES OF LOW ENERGY COSMIC RAYS c46
S. Biswas, R. Chakraborti, R. Cowsik, N. Durgaprasad, P. J Kajarekar, R. K. Singh, M. N. Vahia, J. S. Yadav, N. Dutt, J. N. Goswami (Physical Research Lab., Ahmedabad, India) et al. *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 64-74 Prepared in cooperation with Physical Research Lab., Ahmedabad, India, and ISRO Satellite Centre, Peenya, Bangalore, India (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

IONS (ANURADHA), the experimental payload designed specifically to determine the ionization states, flux, composition, energy spectra and arrival directions of low energy (10 to 100 MeV/amu) anomalous cosmic ray ions of helium to iron in near-Earth space, had a highly successful flight and operation Spacelab-3 mission. The experiment combines the accuracy of a highly sensitive CR-39 nuclear track detector with active components included in the payload to achieve the experimental objectives. Post-flight analysis of detector calibration pieces placed within the payload indicated no measurable changes in detector response due to its exposure in spacelab environment. Nuclear tracks produced by alpha-particles, oxygen group and Fe ions in low energy anomalous cosmic rays were identified. It is calculated that the main detector has recorded high quality events of about 10,000 alpha-particles and similar number of oxygen group and heavier ions of low energy cosmic rays. Author

N87-22112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AUTOGENIC-FEEDBACK TRAINING: A PREVENTIVE METHOD FOR SPACE ADAPTATION SYNDROME c53
Patricia S. Cowings, Joseph C. Sharp, William B. Toscano, Joe Kamiya, and Neal E. Miller (Yale Univ., New Haven, Conn.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 84-90 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 05I

The progress made to date on the reduction of data for Spacelab 3 Shuttle experiment, No. 3AFT23 is reported. Four astronauts participated as subjects in this experiment. Crewmen A and B served as treatment subjects (i.e., received preflight training for control of their own motion sickness symptoms) and Crewmen C and D served as control (i.e., did not receive training). A preliminary evaluation of Autogenic Feedback Training (AFT) was made from visual inspections of graphs that were generated from the preflight and inflight and inflight physiological data which included: (1) Baseline rotating chair tests for all crewmen; (2) Posttraining rotating chair tests of treatment groups subjects; (3) Preflight data from Joint Integrated Simulations for all crewmen; and (4) Flight data for all crewmen during mission days 0 through 4, and mission day 6 for treatment subjects only. A summary of the findings suggested by these data is outlined. Author

N87-22113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANIMAL STUDIES ON SPACELAB-3 c51
C. Schatte, R. Grindeland, P. Callahan, W. Berry, G. Funk, and W. Lencki (Management and Technical Services Co., Philadelphia, Pa.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 75-83 Previously announced as N86-16889 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 06C

The flight of two squirrel monkeys and 24 rats on Spacelab-3 was the first mission to provide hands-on maintenance on animals in a laboratory environment. With few exceptions, the animals grew and behaved normally, were free of chronic stress, and differed from ground controls only for gravity dependent parameters. One of the monkeys exhibited symptoms of space sickness similar to those observed in humans, which suggests squirrel monkeys may be good models for studying the space adaptation syndrome. Among the wide variety of parameters measured in the rats, most notable was the dramatic loss of muscle mass and increased fragility of long bones. Other interesting rat findings were those of suppressed interferom production by spleen cells, defective release of growth hormone by somatrophs, possible dissociation of circadian pacemakers, changes in hepatic lipid and carbohydrate metabolism, and hypersensitivity of marrow cells to erythropoietin. These results portend a strong role for animals in identifying and elucidating the physiological and anatomical responses of mammals to microgravity. Author

N87-22114*# Technion - Israel Inst. of Tech., Haifa. Energy Engineering Center.
COMPUTATION OF ASYMMETRIC SUPERSONIC FLOWS AROUND CONES AT LARGE INCIDENCE Final Report
David Degani 5 Apr. 1987 88 p
(Grant NAGw-609)
(NASA-CR-180617; NAS 1.26:180617) Avail: NTIS HC A05/MF A01

The Schiff-Steger parabolized Navier-Stokes (PNS) code has been modified to allow computation of conical flowfields around cones at high incidence. The improved algorithm of Degani and Schiff has been incorporated with the PNS code. This algorithm adds the cross derivative and circumferential viscous terms to the original PNS code and modifies the algebraic eddy viscosity turbulence model to take into account regions of so called cross-flow separation. Assuming the flowfield is conical (but not necessarily symmetric) a marching stepback procedure is used: the solution is marched one step downstream using improved PNS code and the flow variables are then scaled to place the solution back to the original station. The process is repeated until no change in the flow variables is observed with further marching. The flow variables are then constant along rays of the flowfield. The experiments obtained by Bannik and Nebbeling were chosen as a test case. In these experiments a cone of 7.5 deg. half angle at Mach number 2.94 and Reynolds number 1.372 x 10(7) was tested up 34 deg. angle of attack. At high angle of attack nonconical asymmetric leeward side vortex patterns were observed. In the first set of computations, using an earlier obtained solution of the above cone for angle of attack of 22.6 deg. and at station x=0.5 as a starting solution, the angle of attack was gradually increased up to 34 deg. During this procedure the grid was carfully adjusted to capture the bow shock. A stable, converged symmetric solution was obtained. Since the numerical code converged to a symmetric solution which is not the physical one, the stability was tested by a random perturbation at each point. The possible effect of surface roughness or non perfect body shape was also investigated. It was concluded that although the assumption of conical viscous flows can be very useful for certain cases, it can not be used for the present case. Thus the second part of the investigation attempted to obtain a marching (in space) solution with the PNS

method using the conical solution as initial data. Finally, the solution of the full Navier-Stokes equations was carried out. M.G.

N87-22115# DCW Industries, La Canada, Calif.
DEVELOPMENT OF A COMPLETE MODEL OF TURBULENCE REVISITED Final Report, 1 Dec. 1982 - 31 Oct. 1986
David C. Wilcox Dec. 1986 6 p
(Contract DAAG29-83-C-0003)
(AD-A176392; ARO-19572.4-EG-S) Avail: NTIS HC A02/MF A01 CSCL 20D

The primary technical objective of this research project has been to develop and test a new set of constitutive equations suitable for general engineering applications. In accomplishing this objective, particular emphasis has been focused upon predicting rates of departure from and return to equilibrium. Throughout the research in this project, a secondary goal has been to devise turbulence model equations subject to the self imposed constraints that the resulting equations pose no special difficulties for conventional numerical procedures, and, to the greatest extent possible, reflect much more of the physics of turbulence than previously attempted in an engineering model. GRA

N87-22116*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATION OF THE HYPERSONIC FLOW AROUND LIFTING VEHICLES
Yehia Rizk (Sterling Federal Systems, Inc., Palo Alto, Calif.), Denny Chaussee, and Joseph Steger Apr. 1987 28 p Presented at the Symposium on Aerodynamics of Hypersonic Lifting Vehicles, Bristol, England, 6-9 Apr. 1987; sponsored by AGARD
(NASA-TM-89444; A-87153; NAS 1.15:89444) Avail: NTIS HC A03/MF A01 CSCL 20D

A method for solving the viscous hypersonic flow field around realistic configurations is presented. The numerical procedure for generating the required finite difference grid and the two-factored implicit flow solver are described. Results are presented for the shuttle orbiter and a generic wing-body configuration at hypersonic Mach numbers. Author

N87-22117# Pittsburgh Univ., Pa. Inst. for Computational Mathematics and Applications.
COMPUTATIONAL FLUID DYNAMICS Annual Report, 1 Jun. 1984 - 31 May 1986
Charles A. Hall Jun. 1986 24 p
(Grant AF-AFOSR-0131-84)
(AD-A177171; AFOSR-87-0056TR) Avail: NTIS HC A02/MF A01 CSCL 20D

Implementation of the reduced basis method requires the choice of a subspace and a projector onto that subspace. For an arbitrarily chosen subspace-projector pair, existence of the true solution curve is not sufficient to guarantee the existence of the corresponding reduced basis solution curve. However, when the former curve exists, it has been shown that there are infinitely many subspace-projector pairings, each utilizing an arbitrarily selected subspace, under which the reduced basis solution curve exists. Moreover, the resulting error estimates are of the same nature as those that apply in the more familiar case when a subspace is paired with its orthogonal projector. GRA

N87-22118# Purdue Univ., West Lafayette, Ind.
HEATING AND EVAPORATION OF TURBULENT LIQUID FILMS Annual Progress Report
I. A. Mudawwar, W. G. Tiederman, J. A. Shmerler, J. E. Koskie, W. J. Marsh, and T. H. Lyu Mar. 1987 167 p
(Contract DE-FG02-85ER-13398)
(DE87-005779; DOE/ER-13398/5) Avail: NTIS MF A01

The 1986 annual report includes a complete review of previous research on liquid films and a section describing the Theoretical Modeling of falling films. Previous experimental investigations on sensible and evaporative heating of falling films are described. Turbulence models of freely falling films, and the equations for the analysis of heated and evaporating films are summarized. Experimental and numerical results are reported for the cases of sensible heating and evaporation. For both heating and evaporation there is an agreement between experimental results and numerical predictions based on previous semi-empirical turbulence models at higher Prandtl numbers. At lower Prandtl numbers, where there is greater sensitivity to the eddy diffusivity, there is a greater discrepancy and none of the models predict the experimental trends. DOE

N87-22119 Iowa Univ., Iowa City.
LARGE-SCALE STRUCTURE OF THE TURBULENT WAKE BEHIND A FLAT PLATE Ph.D. Thesis
Srboljub D. Jovic 1986 175 p
Avail: Univ. Microfilms Order No. DA8622782

An experimental study of the developing two-dimensional turbulent wake behind a streamlined flat-plat is reported. The purpose was to understand the evolution of the wake structure from the one characteristic of a boundary layer to that characteristic of the farwake, and to investigate whether organized motions are present in the wake flow just as in other free shear flows. The evolution of the flow and the mixing process in the developing wake was studied by using the well-known heat-aging technique. This consisted of heating very slightly the boundary layer on one side of the plateso that the heat could be used as a passive tracer. The experiments were performed in a wind tunnel at a Reynolds number of 1100. Simultaneous measurements of two components of velocity and local temperature were made. The conditional averaging technique was used to gain better insight into the dynamics of the interface separating the mixed and unmixed fluid in the developing wake. Finally, a selective ensemble averaging technique was successfully used to identify and educe organized large-scale structures present in the wake flow. Dissert. Abstr.

N87-22120# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
BENCH MARK NUMERICAL PROBLEMS
V. H. Ransom 1987 26 p Presented at the DOE International Workshop on Two-phase Flow Fundamentals, Troy, N.Y., 16 Mar. 1987
(Contract DE-AC07-76ID-01570)
(DE86-013480; EGG-M-14586; CONF-870320-1) Avail: NTIS HC A03/MF A01

This paper presents three problems in the study of two-phase flow. The first problem is steady faucet flow - liquid flow in a vertical column. The analytical solution is compared to the numerical solution. The second problem is the oscillating manometer. The analytical solution is compared with a typical numerical solution. The final problem presented is injection of subcooled water into a superheated steam. There is no analytical solution for this problem. DOE

N87-22121# Los Alamos National Lab., N. Mex.
SOME PROGRESS IN STATISTICAL TURBULENCE THEORY
R. H. Kraichnan 1987 37 p Presented at the 5th Seminar on Magnetohydrodynamic Flows and Turbulence, Jerusalem, Israel, 2 Mar. 1987
(Contract W-7405-eng-36)
(DE87-006058; LA-UR-87-519; CONF-870359-1) Avail: NTIS HC A03/MF A01

An examination is made of relationships among several approaches to analytical turbulence theory: approximation by finite sets of moments, renormalized perturbation theory, decimation under symmetry constraints, renormalization-group methods, and the upper-bounding of transport under integral constraints. Most of the discussion assumes isotropic turbulence. Decimation under symmetry constraints plays a unifying role. It promises a rational basis for renormalized perturbation theory and provides links to the other named approaches. DOE

N87-22122*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SHAFT FREQUENCY ON CAVITATION IN A JOURNAL BEARING FOR NONCENTERED CIRCULAR WHIRL
David E. Brewe and M. M. Khonsari (Ohio State Univ.,

Columbus.) 1987 23 p Presented at the 1987 Annual Meeting of the American Society of Lubrication Engineers, Anaheim, Calif., 11-14 May 1987
(NASA-TM-88925; E-3361; NAS 1.15:88925; USAAVSCOM-TR-86-C-41) Avail: NTIS HC A02/MF A01 CSCL 20D

The effect of shaft frequency on the performance of a submerged journal undergoing noncentered circular whirl is examined. The main emphasis of the paper is on the behavior of the vapor cavitation bubble and its effect on the bearing performance as a function of frequency. A cavitation algorithm due to Elrod was implemented in a computer program which solves a time-dependent Reynolds equation. This algorithm automatically handles the boundary conditions by using a switch function and a control volume approach which conserves mass throughout the entire flow. The shaft frequencies in this investigation ranged from 0 rad/s (squeeze-film damper) to -104 rad/s (a case in which oil-whip condition was produced momentarily). For the particular vibration amplitude chosen in this investigation it was observed that vapor cavitation had an effect on the load components for the full range of shaft frequencies investigated. Author

N87-22123# Naval Postgraduate School, Monterey, Calif.
THE HELMHOLTZ THEOREM Final Report, Oct. 1985 - Sep. 1986
A. V. Hershey Sep. 1986 15 p
(AD-A177281; NPS012-86-010) Avail: NTIS HC A02/MF A01 CSCL 12A

The Helmoltz theorem is rederived with rigorous vector analysis. The theorem is valid everywhere within any arbitrary mathematical boundary. Applications of the theorem to hydrodynamics are discussed. GRA

N87-22124# Cornell Univ., Ithaca, N.Y.
DEVELOPMENT OF A MODEL FOR SWIRLING FLOWS Final Report, 1 Jul. 1983 - 30 Jun. 1985
John L. Lumley 24 Oct. 1986 5 p
(Grant AF-AFOSR-0272-83)
(AD-A177302; AFOSR-87-0221TR) Avail: NTIS HC A02/MF A01 CSCL 20D

The purpose of this project was to develop a second order model for weakly swirling flows. The model was based on a successful model for the buoyancy driven mixed layer of the atmosphere. Swirling flows present a challenge to the modeler due to the influence of radial turbulent transport on the radial distribution of azimuthal velocity. This is weakly analogous to the effect of density stratification in a flow with gravity. A radial distribution of angular momentum increasing outward will have a stabilizing influence, and will suppress radial transport and reduce the rate of spread of a scalar marker, while a radial distribution of angular momentum decreasing outward will have the opposite effect. GRA

N87-22125# Illinois Univ., Urbana. Dept. of Chemical Engineering.
PRESSURE GRADIENT EFFECTS IN THE VISCOUS WALL REGION OF A TURBULENT FLOW Progress Report, 1983 - 1986
Douglas S. Finnicum and Thomas J. Hanratty Jan. 1987 288 p
(Contract N00014-82-K-0324)
(AD-A177313; PR-7) Avail: NTIS HC A13/MF A01 CSCL 20D

The effects of an imposed pressure gradient on the viscous wall region of a turbulent flow are presented. Only imposed pressure gradients homogeneous in the streamwise direction are considered. A computational model that neglects streamwise derivatives is used to study imposed pressure gradients constant in time. The shear stress at the edge of the viscous wall region, and not the wall shear stress, is shown to be the proper shear stress to use in scaling the coherent eddy structures responsible for the production of the turbulent kinetic in the viscous wall region. Arguments are presented that show the minimum value corresponds to the point of imminent relaminarization of a turbulent flow. Measurements using electrochemical probes are presented of the variation of the wall shear stress, the turbulent fluctuations of the wall shear stress, and the transverse correlation coefficients of the streamwise velocity gradient at the wall that are caused by the imposition of a sinusoidal pressure gradient on the flow of a turbulent fluid through a two inch pipe. The correlation coefficient measurements are used to provide information about the variation of the streak spacing. Results are presented for pulsations having a constant centerline variation of 10% and dimensionless frequencies, ranging from 0.0012 to 0.0915. GRA

N87-22126# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
ON SUPERCRITICAL FLUIDS: LATTICE EQUATIONS OF STATE. 2: THE ROLE OF THE SEGMENTAL CONTACT SURFACE AREA IN THE UNIFICATION OF MODERN LATTICE MODELS
Eric J. Beckman, Roger S. Porter, and Ron Koningsveld 5 Jan. 1987 70 p
(Contract N00014-83-K-0228)
(AD-A177339; TR-31) Avail: NTIS HC A04/MF A01 CSCL 20D

Many authors have used a lattice consisting of filled and vacant sites to model compressive fluids. Many diverse models may be summarized by a single equation of state, with the various versions representing special cases. Liquid vapor coexistence and PVT data on CO2, SO2 and CHF3 were used to test the general model. The model also tested well on the considerable and consistent isothermal PV data on polystyrene. GRA

N87-22127# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
NUMERICAL STUDIES OF A DETONATION ANALOGUE
J. F. Clarke, P. L. Roe, L. G. Simmonds, and E. F. Toro Mar. 1987 87 p
(CAR-8704; ISBN-0-947767-57-6) Avail: NTIS HC A05/MF A01

Topics addressed include: an analog model for detonation-wave behavior; MacCormack finite difference method; Godunov method; random choice method; and finite element method. B.G.

N87-22128# Utah Univ., Salt Lake City. Fluid Dynamics Lab.
FLUID MECHANICS OF SPINNING ROCKETS Final Report, 1 Jan. 1984 - 1 Dec. 1985
G. A. Flandro, W. K. VanMoorhem, R. Shorthill, K. Chen, and M. Woolsey Jan. 1987 179 p
(Contract F04611-83-K-0047)
(AD-A177350; AFRPL-TR-86-072) Avail: NTIS HC A09/MF A01 CSCL 20D

This report presents the results of a detailed investigation of the influence of time-dependent combustion gas flows on the attitude dynamics of spinning rocket propelled space vehicles. The work was motivated by a need to understand the origins of a potentially serious system performance problem first detected in the PAM-D series of spin stabilized upper stages. Small wobbling (often referred to as nutation or coning) is induced during separation of the rocket motor burn. The growth ceased abruptly at motor burnout, and final cone angles as large as 17 deg were reached in some flights. The same phenomenon was encountered in two flights of the PAM-DII, a similar vehicle utilizing a larger motor. Conventional theories of spinning rocket dynamics failed to explain this behavior. Since the telemetry data shows that the severity of the problem depends on spacecraft mass properties and other system parameters, it is crucial that the origins of the instability be understood completely in order that serious mission degradation can be avoided in future orbit raising operations. A costly interim fix, which sidesteps the need to understand the physical origins of the problem, is the use of a strap-on nutation control system as used in the Air Force SGS II missions. GRA

N87-22129# Naval Ship Research and Development Center, Bethesda, Md.
EDDY VISCOSITIES AND MIXING LENGTHS FOR TURBULENT BOUNDARY LAYERS ON FLAT PLATES, SMOOTH OR ROUGH Final Report
Paul S. Granville Dec. 1986 41 p
(AD-A177415; DTNSRDC-86/067) Avail: NTIS HC A03/MF A01 CSCL 20D

Algebraic formulas are derived for the eddy viscosities and mixing lengths of turbulent boundary layers on flat plates on the basis of the similarity laws and the equations of motion. Both smooth and rough surfaces are considered. The effect of low Reynolds numbers, especially on rough surfaces, is included. Agreement with Klebanoff's measurements is excellent. GRA

N87-22130# Woods Hole Oceanographic Institution, Mass.
SUMMER STUDY PROGRAM IN GEOPHYSICAL FLUID DYNAMICS: ORDER AND DISORDER IN TURBULENT SHEAR FLOW
Melvin E. Stern Dec. 1986 290 p Program held in Woods Hole, Mass., 1986
(Contract N00014-82-G-0079; Grant NSF DMS-85-04166)
(AD-A177571; WHOI-86-45) Avail: NTIS HC A13/MF A01 CSCL 20D

This Summer Study Program on Geophysical Fluid Dynamics included sessions on the following: Order and disorder in turbulent shear flow: What is Coherent Structure; Statistical Measures of Turbulence; Coherent Structures in the Laboratory and in nature; Equations of Motion; Shear Flow Instability; Turbulence and Flow Instability; Euler Description of Fluctuating Field; Coherent Structure Modeling; Modeling; and Numerical Simulation. GRA

N87-22131# Cornell Univ., Ithaca, N.Y.
A STUDY OF TURBULENT BOUNDARY LAYER STRUCTURE Final Report, 1 Feb. 1983 - 31 Jan. 1985
John L. Lumley 24 Oct. 1986 6 p
(Grant AF-AFOSR-0132-83)
(AD-A177609; AFOSR-87-0216TR) Avail: NTIS HC A02/MF A01 CSCL 20D

The purpose of this investigation was to complete analysis of space-time correlation measurements of two velocity components in the wall region of a turbulent pipe flow. The third component was obtained form continuity, and eigenfunctions of the cross-spectral density tensor extracted. GRA

N87-22132# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
VORTEX LOOP DYNAMICS: A PHENOMENOLOGICAL MODEL FOR TURBULENT BOUNDARY LAYER STRUCTURE Final Report, 1 Jan. 1982 - 31 Dec. 1986
Thomas L. Doligalski and Stephen M. Batill Dec. 1986 99 p
(Grant AF-AFOSR-0115-82)
(AD-A177838; AFOSR-87-0261TR) Avail: NTIS HC A05/MF A01 CSCL 20D

The results of a combined analytic/experimental study of the unsteady development of three dimensional vortex loops in the vicinity of solid surfaces and under the influence of a crossflow is detailed. It has long been recognized that a three-dimensional convecting stretching vortex loop is a major component of turbulent boundary layer flow. The initial development of this structure is examined by numerically and experimentally studying the temporal and spatial interaction between a two dimensional viscous jet and a viscous crossflow. In the cases considered the crossflow caused the ejected fluid from the jet to be rolled up into a vortex structure which appeared to be similar to the loop-like coherent vortex structure found in turbulent boundary layers. To study the long time development of vortex loops, a combined numeric and experimental approach is again used. These synergistic studies indicate that substantial loop growth occurs only due to the presence of an imposed shear, such as that experienced by the loop within the turbulent boundary layer. This interaction between the loop and the imposed crossflow plays the dominant role in the loop formation process. GRA

N87-22133*# National Aeronautics and Space Administration, Washington, D.C.
CHARACTERISTIC FEATURES OF THE OPERATION OF HIGH-TEMPERATURE HEAT PIPES WITH A NONCONDESABLE GAS
V. I. Tolubinskiy and Ye. N. Shevchuk May 1987 13 p Transl. into ENGLISH from the mono. "Osobennosti Raboty Vysokotemperaturnykh Teplovykh Trub s Nekondensiruyushchimsya Gazom" Kiev, USSR, Naukova Dumka, 1985 p 3-10 Original language document was announced in IAA as A86-36702 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TT-20015; NAS 1.77:20015) Avail: NTIS HC A02/MF A01 CSCL 20D

The principal concepts related to the nature of the processes occurring in high-temperature heat pipes with a noncondensable gas are examined, and guidelines for the development of such heat pipes are presented. The discussion is illustrated by experimental results obtained for a horizontal sodium heat pipe (diameter, 18/1 mm; length, 710 mm). In particular, attention is given to the starting dynamics and mechanisms, the shape of the vapor-gas front, and the vapor-gas front velocity. Author

N87-22134# Minnesota Univ., Minneapolis.
AN EXPERIMENTAL INVESTIGATION ON THE FLOW AROUND A CIRCULAR CYLINDER IN THE FIRST CRITICAL SUBREGION Ph.D. Thesis
Hyun Jin Kim 1986 248 p
Avail: Univ. Microfilms Order No. DA8703410

An experimental investigation has been carried out on the flow transitions around a smooth circular cylinder in the initial stage of the critical Reynolds number region, where drag coefficient starts to decrease. In this Reynolds number region, intermittent reattachment of the separated boundary layer was found, while only initial separation position excursion was observed in the subcritical region. Large spanwise variations in the surface pressure and wake velocity observed in the first critical subregion were associated with local wake width pulsations caused by spanwise phase variations in the unsteady flow reattachment. Low-frequency amplitude modulations of the vortex shedding in the subcritical region was related to the two-dimensional movement of the separation point, and deterioration of the vortex shedding inherent to the first critical subregion flow was ascribed to the formation of the unsteady spanwise flow structure as well as to the unsteady flow reattachment itself. Dissert. Abstr.

N87-22135 Princeton Univ., N. J.
CALCULATION OF SEPARATED, NONSTATIONARY, TWO DIMENSIONAL, TURBULENT FLOWS AROUND BLUFF BODIES USING REYNOLDS STRESS CLOSURE TURBULENCE MODELING Ph.D. Thesis
Brian Richard Smith 1987 305 p
Avail: Univ. Microfilms Order No. DA8702167

Separated, turbulent flows are calculated using a Reynolds stress closure model. The model consists of transport equations for each of the Reynolds stress components and for the volume integral of the two-point correlation function. Several alternate forms of model terms in the Reynolds stress transport equations which have been proposed are considered in order to assess their effects in separated flow calculations. The calculations are performed on two dimensional flows. The mean momentum equations are solved using vorticity - stream function coordinates. The computations are carried out with an explicit finite difference method capable of handling time dependent flow problems. The backward facing step calculations show the Mellor turbulence model to perform well compared to other popular turbulence models. The flow around a bluff plate normal to the flow is also investigated, and compared to experimental results. This flow is of interest since it exhibits unsteady shedding in the near wake, and the applicability of Reynolds stress closure models to flows of this type has not been established. Dissert. Abstr.

N87-22136# Naval Postgraduate School, Monterey, Calif.
THE EFFECTS OF AN EMBEDDED VORTEX ON A FILM COOLED TURBULENT BOUNDARY LAYER M.S. Thesis
Stephen L. Joseph Dec. 1986 222 p
(Contract MIPR-FY1455-86-N0616)
(AD-A177785) Avail: NTIS HC A10/MF A01 CSCL 20D

Secondary flow effects on endwalls, blades, and combustion chambers of gas turbine engines are modelled. Measurements were made in a turbulent boundary layer developing over a flat plate, using a single row of injection holes spaced three diameters apart inclined at 30 degrees with respect to horizontal. The injection system was designed to provide uniform injection temperatures for various blowing rates with discharge coefficients ranging from 0.58 to 0.73. The heat transfer surface was designed to provide content heat flux with adjustable temperature range. Experimental heat transfer results were obtained with a turbulent boundary layer only, with boundary layer and injection of film cooling, with boundary layer and embedded vortex, and finally with boundary layer, film cooling, and embedded vortex. The effects of the vortex on heat transfer in the film cooled boundary layer are significant and important: (1) On the downwash side of the vortex, heat transfer is augmented, effects of the film cooling are negated and local hot spots will exist in engines. (2) Near the upwash side of the vortex coolant is pushed to the side of the vortex, appearing to augment the protection provided by film cooling. Author

N87-22137# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
ROUND TABLE DISCUSSION ON MODELLING OF TIME-VARIANT FLOWS USING VORTEX DYNAMICS
Loughton, England Feb. 1987 104 p In ENGLISH and FRENCH Discussion held in Aix-en-Provence, France, 10 Apr. 1986
(AGARD-AR-239; ISBN-92-835-0405-4) Copyright Avail: NTIS HC A06/MF A01

In recent years there has been a marked growth in the applications of vortex dynamics to time-varying flows, usually involving separated regions with vortical structures. The flow models are based on distributions of vortex elements which may vary in complexity. This Report is a compilation of invited papers on the topic presented at the AGARD Fluid Dynamics Panel Round Table Discussion held in Aix-en-Provence, France, in April 1986. The papers cover current and projected developments in France, Germany, Greece, Italy, Netherlands, UK and USA. The Report provides a good overall view of the state of the art of the topic, covering both the achievements and the deficiencies requiring future research. The outstanding problems center on how the effects of viscosity can be realistically modelled, particularly in three dimensional flow, and what might be done to deal with the effects of compressibility. For individual titles, see N87-22138 through N87-22144.

N87-22138# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
COMPUTATION OF UNSTEADY FLOWS USING THE POINT VORTEX METHOD [CALCUL D'ECOULEMENTS INSTATIONNAIRES PAR LA METHODE DES TOURBILLONS PONCTUELS]
Y. Morchoisne *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 15 p In FRENCH (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

The computation of unsteady flow of an inviscid, incompressible fluid around wing, rotor, or fuselage configurations may be carried out with the various singularity methods. The object of this report is to briefly describe the doublet-point vortex methods and discuss some applications which have been recently investigated including a double delta wing, a rotor in forward flight, a helicopter fuselage, and a helicopter in forward flight. M.G.

N87-22139# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. for Theoretical Fluid Mechanics.
VORTEX DYNAMICS: A REPORT ON WORK IN GERMANY
H. Oertel *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 10 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

This article reviews the numerical work relevant to the vortex dynamics method carried out in Germany supplemented by results from the Franco-German Research Institute Saint Louis, ISL. The introduction includes the development of two- and three-dimensional simulation methods and is followed by a discussion of the results in shear layers, trailing far wakes, aerodynamical profile flow simulation with spoiler and the simulation of three-dimensional structures in wakes. Author

N87-22140# Defense Industries Directorate, Athens (Greece).
SIMULATION OF IMPINGING SHEAR LAYERS USING VORTEX DYNAMICS
Argyris G. Panaras *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 26 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

Organized vortices have been observed within the oscillating shear layers that impinge on a surface. It is believed that the feedback force necessary for the generation of these vortices is produced by their interaction with the reattachment surface. In the present work, models for studying the interaction of lines or of finite-area vortices with edges that simulate cavity-type of flows or edge-tones are examined. According to the analysis, the interaction of vortices with an edge induces periodic pressure fluctuations similar to those measured in oscillating flows. Also, when the geometry of an edge is such that no oscillation has been observed, the amplitude of the induced pressure pulses is insignificant. Thus, the hypothesis about the role of the vortex/edge interaction is supported. Author

N87-22141# Politecnico di Torino (Italy). Dept. of Aerospace Engineering.
VORTEX DYNAMICS-SURVEY OF THE ACTIVITY IN ITALY
M. Germano *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 6 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

The activity in modelling time variant flows using vortex dynamics is at present very limited in Italy. Moreover the contributions are principally in fundamental areas or in areas outside the aeronautical field. Author

N87-22142# National Aerospace Lab., Amsterdam (Netherlands).
MODELLING OF TIME-VARIANT FLOWS USING VORTEX DYNAMICS-ACTIVITIES IN THE NETHERLANDS
H. W. M. Hoeijmakers *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 9 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

Activities in the Netherlands in the area of simulating low-speed flows using vortex elements are summarized. Aspects of some of the methods developed are highlighted and plans for future work are indicated. Author

N87-22143# Cambridge Univ. (England). Dept. of Engineering.
FLOW MODELS USING VORTEX DYNAMICS: WORK IN THE UNITED KINGDOM
D. J. Maull *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 18 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

A review is given of work in the United Kingdom on vortex dynamics. This method of modelling separated flows is applied to unsteady flow around aerofoils, bluff bodies, boundary layers and pollution studies. Many applications are given and some of the difficulties in using the method described. Author

N87-22144# California Inst. of Tech., Pasadena.
RECENT ACTIVITY IN VORTEX METHODS IN THE UNITED STATES
A. Leonard *In* AGARD Round Table Discussion on Modelling of Time-Variant Flows Using Vortex Dynamics Feb. 1987 10 p (For primary document see N87-22137 15-34)
Copyright Avail: NTIS HC A06/MF A01

Vortex methods for flow simulation continue to have a wide-ranging appeal as a means of developing a better understanding of a complex flow and, in many cases, obtaining useful quantitative data. Part of the appeal is in the relative simplicity of the computer code that is required to do the job and, usually, in the relatively low computational cost. For example, experience has shown that some fairly complex three-dimensional flows may be simulated with a hundred or so vortex elements (sections of a vortex tube). Another aspect of the appeal is the visualization of the flow in terms of vortex dynamics, an aspect that aids in the physical understanding of the flow. In this paper, recent activity in the United States concerning flow simulation with vortex methods is reviewed. We consider three main areas of effort: separated flows in two-dimensions (Section 2), simulations using the method of contour dynamics (Section 3) and three-dimensional flows (Section 4). Finally, in Section 5, we cite directions for future efforts that look particularly promising. Author

N87-22145# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Consultant and Exchange Program.
COMPUTATION OF THREE-DIMENSIONAL BOUNDARY LAYERS INCLUDING SEPARATION
Loughton, England Feb. 1987 218 p AGARD Special Course held in Rhode-St-Genese, Belgium, 14-18 Apr. 1986; sponsored by the von Karman Inst. and AGARD
(AGARD-R-741; ISBN-92-835-0407-0) Copyright Avail: NTIS HC A10/MF A01

The Special Course on Computation of Three-Dimensional Boundary Layers Including Separation was sponsored by the AGARD Fluid Dynamics Panel and the von Karman Institute and presented at the von Karman Institute, Rhode-Saint-Genese, Belgium, on 14 to 18 April 1986. The Course presented a comprehensive review of experimental aspects of three-dimensional boundary layers with emphasis on the use of fundamental experiments to improve models for turbulence and transition. A review of various calculation methods was given, including the calculation of transition and calculations which aid in aerodynamic design. Numerical differential methods were discussed and viscous-inviscid interactive schemes and procedures were reviewed. Calculations of corner and tip region flows was covered in detail. For individual titles, see N87-22146 through N87-22153.

N87-22146# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Aerothermodynamique.
THREE-DIMENSIONAL BOUNDARY LAYERS: INTRODUCTION TO CALCULATION METHODS
Jean Cousteix *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 49 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

This paper gives an outline of problems encountered when faced with the calculation of three-dimensional boundary layers. The various topics which are discussed are: geometry of axis systems, boundary layer equations, global equations, nature of the system of equations, integral methods, singularities in boundary layer calculations, numerical techniques, turbulence modelling. Author

N87-22147# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
PHYSICS AND MODELLING OF THREE-DIMENSIONAL BOUNDARY LAYERS
P. Bradshaw *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 19 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

This section of the course is an introduction to the physics of three-dimensional (3D) turbulent flows and a discussion of modelling - the use of experimental data in developing calculation methods. Only conventional Reynolds-averaged calculation methods will be discussed: for simplicity, only differential methods, in which variables are predicted at each point in the boundary layer, will be treated, but similar principles should apply to integral methods. Author

N87-22148# National Aerospace Lab., Amsterdam (Netherlands).
THREE-DIMENSIONAL SHEAR LAYER EXPERIMENTS AND THEIR USE AS TEST CASES FOR CALCULATION METHODS
B. vandenBerg *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 13 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

Three-dimensional shear layer experiments are discussed with a view to those developing calculation methods. The emphasis is on the selection of useful experiments for comparisons with calculations and the proper way to perform the comparisons. A review of more recent three-dimensional shear layer experiments is included. Author

N87-22149# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
THREE-DIMENSIONAL LAYERS: LAMINAR-TURBULENT TRANSITION
Daniel Arnal *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 34 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

The first part of this paper is devoted to a brief survey of transition problems in two-dimensional flows. The main elements of laminar instability theory are presented and used for elaborating some practical transition criteria. In three-dimensional situations, the problem is much more complex, because transition may occur through streamwise instability, cross-flow instability or leading edge contamination. It is assumed that the streamwise instability can be studied by using two-dimensional results. On the contrary, the cross-flow instability and the leading edge contamination constitute typical features of three-dimensional flows, as it is illustrated by experimental results. The extension of linear stability theory to these last problems is discussed, and transition criteria are developed. Moreover an intermittency method allows the transition region to be calculated. These techniques are applied to swept wings and bodies at incidence. Author

N87-22150# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
EVALUATION OF RESULTS OF BOUNDARY-LAYER CALCULATIONS WITH REGARD TO DESIGN AERODYNAMICS
E. H. Hirschel *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 29 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

The tools for the preprocessing of geometrical and inviscid flow data for boundary-layer computations, and for the postprocessing of the computed data are discussed. After a presentation of some important basic properties of three-dimensional boundary layers, the definition of coordinates, the computation of the metric properties, and transformation laws are given. Then the relations for the boundary-layer parameters, which are used in engineering work, like the wall-shear stress, friction forces, skin-friction lines, displacement properties etc., are

presented. They are complemented with applications from design aerodynamics. The question what can be seen from boundary-layer results with regard to separation is then addressed. Basic topographical considerations are made, and basic topological rules are demonstrated. Finally practical separation indicators which can be applied to boundary-layer results are listed. Applications from design aerodynamics close the paper. Author

N87-22151# Douglas Aircraft Co., Inc., Long Beach, Calif.
AN APPROACH TO PRACTICAL AERODYNAMIC CALCULATIONS
Tuncer Cebeci *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 40 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

The emphasis of these lectures is on the numerical solution of three-dimensional boundary-layer equations using forms of Keller's Box scheme and interaction with solutions of inviscid-flow equations. Calculations are described for the flow over a circular cylinder started impulsively from rest and a prolate spheroid at angle of attack, and were obtained with prescribed free-stream velocity distribution; the results emphasize the need for the Characteristic Box finite-difference scheme, which automatically satisfies the numerical stability criterion, in regions of flow where the w-velocity component is negative. Corresponding calculations, this time with a novel interactive method, are reported for the flow over the leading edge of a thin ellipse, over an oscillating airfoil and around wings; the results confirm that the interactive procedure provides accurate solutions, without numerical problems, in regions of flow separation. Author

N87-22152# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PROGRESS IN VISCOUS-INVISCID SOLVERS (VIS)
J. C. LeBalleur *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 3 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

The aim of these lectures was an introduction to the further extensions of boundary layer theory, which rely on the development of full viscous-inviscid interaction solvers, in three-dimensional flows. At the present time, however, the state of the art still does not accommodate the full 3D-problem. It is more or less restricted, on one hand, to advances in uncoupled 3D-boundary layer problems, direct or inverse, and, on the other hand, to developments in full viscous-inviscid solvers for the 2D or quasi-3D infinite swept wing flows, the latter developments involving the coupling and the calculation of quasi-3D closed separations. The present lectures were mainly devoted to the developments obtained by the author and his colleagues in these two areas. These developments were outlined after describing shortly the different strategies which can be used to split the Navier-Stokes problem into a viscous-inviscid interaction problem, in two or three dimensions. Author

N87-22153# Scientific Research Associates, Inc., Glastonbury, Conn.
COMPUTATION OF TIP AND CORNER REGION FLOWS
T. R. Govindam and H. McDonald *In* AGARD Computation of Three-Dimensional Boundary Layers Including Separation Feb. 1987 20 p (For primary document see N87-22145 15-34)
Copyright Avail: NTIS HC A10/MF A01

The flow field in corner and tip regions of wings and propellers is complex, three-dimensional, and viscous with large secondary/transverse velocities. The large secondary velocities, usually associated with streamwise vorticity development in the flow, preclude the use of conventional boundary-layer solution techniques to compute such flow fields. On the other hand, solution techniques for the full Navier-Stokes equations that adequately resolve the length scales of tip and corner region flow fields would require formidable computer resources for use routinely. Sets of approximate three-dimensional viscous flow equations which are applicable to tip and corner region flow fields and which can be solved economically are sought. Clearly, economy of solution must result from approximations to the governing equations for such procedures to be attractive. A spatial marching computation procedure that solves approximate three-dimensional viscous flow equations economically is presented here and application of the procedure to compute tip and corner region flow fields discussed. Author

N87-22154# Technische Univ., Berlin (West Germany).
THE NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR A HEATED CYLINDER NEAR WALLS Ph.D. Thesis [DIE NUMERISCHE LOESUNG DER NAVIER-STOKESSCHEN GLEICHUNGEN FUER EINEN BEHEIZTEN ZYLINDER IN WANDNAEHE MIT BERUECKSICHTIGUNG DES WAERMEUEBERGANGS]
Detlef Wacker 1985 177 p In GERMAN
(ETN-87-99346) Avail: NTIS HC A09/MF A01

The numerical solution of the Navier-Stokes equations and energy equation of plane incompressible laminar flows is presented. The heat flow around the cylinder depends on the wall material. A universal equation is given for the ideal heat-flow near walls. Differential and relaxation methods are used. ESA

N87-22155# Technische Univ., Munich (West Germany). Fakultaet fuer Maschinenwesen.
NUMERICAL SIMULATION OF LAMINAR AND TURBULENT FLOWS WITH RECIRCULATION OVER QUADRATIC CAVITIES Ph.D. Thesis [NUMERISCHE SIMULATION LAMINARER UND TURBULENTER STROEMUNGEN MIT REZIRKULATION AM BEISPIEL DER UEBERSTROEMTEN QUADRATISCHEN KAVITAET]
W. Josef Schmid 1985 240 p In GERMAN
(ETN-87-99346) Avail: NTIS HC A07/MF A01

Numerical solutions of cavity flows are compared with other methods, e.g., three dimensional flow, finite element methods. Influences of the Reynolds number and the turbulence model on the flow-mechanical parameters are discussed. The numerical simulation is based on the program Champion. ESA

N87-22156# Technische Univ., Hanover (West Germany). Inst. fuer Maschinenwesen.
HEAT TRANSFER AND FLOW RESISTANCE IN ARTIFICIALLY ROUGHENED PIPES Ph.D. Thesis [WAERMEUEBERGANG UND STROEMUNGSWIDERSTAND IN ROHREN MIT KUENSTLICHEN RAUHIGKEITEN]
Eckhard Kreipe 1985 134 p In GERMAN
(ETN-87-99353) Avail: NTIS HC A07/MF A01

For heat transfer between a gas and a fluid medium, the surface of the gas medium was optimized by using rectangular ribs. To intensify the heat transfer in pipes, a systematic roughening of the surface is proposed and its influence on the flow resistance discussed. A model for the relevant information on the turbulent convective heat transfer in relation to surface roughness is presented. ESA

N87-22157# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
TRANSFORMATION FOR PROBLEMS WITH A CURVED BOUNDARY
A. J. Croft and S. G. Sajjadi Apr. 1984 18 p
(ETN-87-99828) Avail: NTIS HC A02/MF A01

A transformation for problems concerning potential flow over curved boundaries, where the boundary of the fluid has infinitely many cusp-like crests, spaced periodically in a horizontal direction is described. The method uses a conformal transformation which maps the domain of the flow onto the upper half plane. ESA

N87-22158# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
THEORY OF WEAK TURBULENCE IN FLUIDS AND PLASMAS
S. G. Sajjadi Sep. 1986 66 p
(ETN-87-99829) Avail: NTIS HC A04/MF A01

The theories of weak turbulence in the simplified models are used to show that turbulence motion can be generated under the influence of an unperturbed stable limit cycle. Concepts such as bifurcations, chaos, and strange attractors play an important role. The study of a large number of interacting dissipative modes demonstrates the appearance of a strange attractor in the turbulence evolution theory, first suggested by Landau. The results show that the main stochastic characteristics of the dissipative system are similar to those of Hamiltonian systems, such as the exponential damping of the correlation function. ESA

N87-22159# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.

MAGNETOHYDRODYNAMICS OF A LIQUID IN AN INFINITE CHANNEL

A. J. Croft Sep. 1984 25 p

(ETN-87-99833) Avail: NTIS HC A02/MF A01

The problem of a conducting liquid flowing in an infinite straight channel with insulated vertical walls and base in the presence of a transverse magnetic field is solved analytically using the Hunt-Stewartson boundary layer technique. The velocity profile, nondimensionalized with respect to the core velocity, through the boundary layer for two points symmetrically placed with respect to the center line of the free surface is given. The curves are asymmetrical with respect to the center line, while at the center there is no variation through the layer. The corresponding curves for the secondary boundary layer at the base do not exhibit this characteristic, but instead increase monotonically from zero to unity. ESA

N87-22160*# Wisconsin Univ., Milwaukee. Dept. of Mechanical Engineering.

A TRANSPORT MODEL OF THE TURBULENT SCALAR-VELOCITY Status Report, Feb. - May 1987

R. S. Amano, P. Goel, and J. C. Chai May 1987 42 p

(Grant NAG8-617)

(NASA-CR-180605; NAS 1.26:180605; Rept-332E/3389E) Avail: NTIS HC A03/MF A01 CSCL 20D

Performance tests of the third-order turbulence closure for predictions of separating and recirculating flows in backward-facing steps were studied. Computations of the momentum and temperature fields in the flow domain being considered entail the solution of time-averaged transport equations containing the second-order turbulent fluctuating products. The triple products, which are responsible for the diffusive transport of the second-order products, attain greater significance in separating and reattaching flows. The computations are compared with several algebraic models and with the experimental data. The prediction was improved considerably, particularly in the separated shear layer. Computations are further made for the temperature-velocity double products and triple products. Finally, several advantages were observed in the usage of the transport equations for the evaluation of the turbulence triple products; one of the most important features is that the transport model can always take the effects of convection and diffusion into account in strong convective shear flows such as reattaching separated layers while conventional algebraic models cannot account for these effects in the evaluation of turbulence variables. Author

N87-22161# Dynatech R/D Co., Cambridge, Mass.

POTENTIAL ROLE OF SUPERCRITICAL FLUID PROCESSES IN ABSORPTION HEAT PUMPS Final Report, Mar. - Nov. 1986

M. K. Gollin Dec. 1986 67 p

(Contract GRI-5086-260-1236)

(PB87-160594; GRI-86/0273) Avail: NTIS HC A04/MF A01 CSCL 20D

An investigation into the characteristics of supercritical fluid separation process was undertaken to determine their potential to improve the efficiency of gas fired absorption heat pumps. A literature survey was carried out to determine the current state of supercritical fluid separation and the characteristics of the system analyzed. The solubility power of supercritical fluids was found to be extremely sensitive to small variations in temperature and pressure close to the critical point. The use of supercritical fluid extraction was found to be inappropriate for use with gas fired heat pumps due to large parasitic electrical loads, high pressure levels, low energy transfer per unit mass of circulated fluid, and equipment design problems. The use of supercritical fluid extraction appears to be limited to processes where either a high value material is produced or where very large plants can be constructed to allow the economy of scale to offset the high capital costs incurred by operation at high pressure. GRA

N87-22162# Applied Management Sciences, Inc., Silver Spring, Md.

STATUS OF COMPRESSORS AND ELECTRIC HEAT PUMPS: REVIEW OF RESEARCH

S. Katsenelenbogen 10 Jan. 1986 81 p

(Contract GRI-5082-242-0898)

(PB87-169801; GRI-86/0014) Avail: NTIS HC A05/MF A01 CSCL 20D

The purpose of the report was to determine the thrust of electric heat pump and compressor research completed in the past few years, to provide an update on the accomplishments of on-going projects, to determine their applicability to GRI gas heat pump developments, and to assist GRI in formulating its R&D strategy. A survey of publicly available publications on EPRI-sponsored and other sources is presented in abstract form. Technical innovations in electric heat pump components such as compressors are specifically addressed. The experimentally observed or projected improvements in efficiency, reliability, energy consumption, and cost are emphasized. Manufacturers' data on the state-of-the-art products is provided. GRA

N87-22163*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE NONLINEAR INTERACTION OF TOLLMIEN-SCHLICHTING WAVES AND TAYLOR-GOERTLER VORTICES IN CURVED CHANNEL FLOWS Final Report

P. Hall and F. T. Smith (University Coll., London, England) Apr. 1987 39 p Submitted for publication

(Contract NAS1-18107)

(NASA-CR-178283; ICASE-87-25; NAS 1.26:178283) Avail: NTIS HC A03/MF A01 CSCL 20D

It is known that a viscous fluid flow with curved streamlines can support both Tollmien-Schlichting and Taylor-Goertler instabilities. In a situation where both modes are possible on the basis of linear theory a nonlinear theory must be used to determine the effect of the interaction of the instabilities. The details of this interaction are of practical importance because of its possible catastrophic effects on mechanisms used for laminar flow control. This interaction is studied in the context of fully developed flows in curved channels. A part form technical differences associated with boundary layer growth the structures of the instabilities in this flow are very similar to those in the practically more important external boundary layer situation. The interaction is shown to have two distinct phases depending on the size of the disturbances. At very low amplitudes two oblique Tollmein-Schlichting waves interact with a Goertler vortex in such a manner that the amplitudes become infinite at a finite time. This type of interaction is described by ordinary differential amplitude equations with quadratic nonlinearities. Author

N87-22164# California Univ., Los Angeles. Dept. of Mechanical, Aerospace and Nuclear Engineering.

ENHANCEMENT OF CRITICAL HEAT FLUX IN TUBES USING STAGED TANGENTIAL FLOW INJECTION Progress Report

V. K. Dhir 1987 13 p

(Contract DE-FG03-85ER-13360)

(DE87-004589; UCLA-ENG-P-5566-C-86) Avail: NTIS HC A02

Experimental studies of the enhancement in single and two phase heat transfer from tubes subjected to tangential flow injection have been continuing. Investigations using water as the test liquid have been focused on: single phase heat transfer coefficients; two phase heat transfer coefficients under subcooled boiling conditions; subcooled critical heat fluxes; and modeling of the

enhancement under swirl flow conditions. With tangential injection up to four fold increase in the average heat transfer coefficient has been observed. During subcooled boiling the enhancement is relatively small. However swirl induced centripetal force increases vapor escape velocity and as a result higher critical heat fluxes can be accommodated. In the range of flow parameters studied up to 40% enhancement in critical heat flux has been observed with single stage injection. This enhancement is slightly less than that obtained with Freon-113. The mechanistic reasons for this observation are currently being investigated. DOE

N87-22165# Oak Ridge National Lab., Tenn.
THERMODYNAMIC PROPERTIES OF AQUEOUS TERNARY SOLUTIONS RELEVANT TO CHEMICAL HEAT PUMPS Final Report
M. R. Ally Mar. 1987 42 p
(Contract DE-AC05-84OR-21400)
(DE87-007799; ORNL/TM-10258) Avail: NTIS HC A03/MF A01

Polynomial expressions are developed that correlate experimental vapor-liquid-equilibrium (VLE) and specific enthalpy concentration data for a newly developed ternary absorption fluid (LiNO3-KNO3-NaNO3). The development of these expressions are an important step toward using existing ORNL computer software to evaluate heat pump performance. A canned least-square-fit program, POLFIT.BAS, was invoked to obtain the polynomial coefficients. Results show that the maximum deviation between correlated and actual values is less than 3% for vapor pressure and enthalpy. This is considered sufficiently accurate for heat pump cycle performance studies. DOE

N87-22166# National Aeronautical Lab., Bangalore (India). Propulsion Div.
PRESSURE, VELOCITY, FLOW DIRECTION AND MASS FLOW MEASUREMENTS IN CASCADES AND TURBOMACHINERY TESTING
Q. H. Nagpurwala Oct. 1986 49 p Presented at the Short Term Advanced Educational Programme on Cascade Testing of Turbomachinery Blades, Hyderabad, India, 7-18 Dec. 1981
(NAL-SP-8619) Avail: NTIS HC A03/MF A01

Presented is the text of a lecture delivered at the Short Term Advanced Educational Program on Cascade Testing of Turbomachinery Blades at Hyderabad during December 7 to 18, 1981. It deals mainly with the pressure probe methods for measurements in 2-D cascades; however some aspects of measurements in rotating turbomachines are also discussed for the sake of completeness. General criteria for the selection of aerodynamic probes are outlined and the merits and demerits of some typical probes used in practice are discussed. Various devices available for the measurement of mass flow rate are also described. Methods for calibration of aerodynamic probes and flow measuring devices are presented and the use of calibration graphs is discussed. Author

N87-22167# National Aeronautical Lab., Bangalore (India). Propulsion Div.
THROUGH FLOW ANALYSIS WITHIN AXIAL FLOW TURBOMACHINERY BLADE ROWS
H. Girigoswami Sep. 1986 16 p
(NAL-PD-PR-8609) Avail: NTIS HC A02/MF A01

Using Katsanis' Through Flow Code, inviscid flow through an axial flow compressor rotor blade as well as flow through inlet guide vanes are analyzed and the computed parameters such as meridional velocity distribution, axial velocity distribution along radial lines, and velocity distribution over blade surfaces are presented. Author

N87-22168# National Aerospace Lab., Tokyo (Japan).
ANALYSIS OF TWO-DIMENSIONAL TURBINE CASCADE FLOW BY FINITE AREA METHOD: COMPARISON OF NUMERICAL AND EXPERIMENTAL RESULTS
Ryousaku Hashimoto and Hideaki Nishimura 1985 17 p In JAPANESE; ENGLISH summary
(NAL-TR-865; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A two-dimensional time marching blade-to-blade flow analysis program was employed to analyze the transonic turbine cascade flows. The transonic turbine cascade flows are numerically calculated for several outlet Mach numbers and inlet angles. The computed airfoil pressure distributions have been compared with the experimental results. The comparison shows excellent agreement for subcritical and supercritical flow with weak shock wave. Author

N87-22169# National Aerospace Lab., Tokyo (Japan).
ESTIMATION OF DIVERGENCE AND FLUTTER BOUNDARIES FROM LOCALLY STATIONARY RANDOM RESPONSES
Yasukatsu Ando and Yuji Matsuzaki 1986 16 p In JAPANESE; ENGLISH summary
(NAL-TR-898; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

A local, stationary process method for predicting flutter and divergence boundaries is presented. The method was applied to response signals of wing models due to flow turbulence measured in subcritical flutter and divergence tests in which the dynamic pressure was increased at a constant speed with the Mach number being fixed. A long nonstationary response record was divided into many contiguous equally short intervals in which the response was assumed to be locally stationary. The random response was assumed to be represented by the autoregressive process. The parameters of the process were evaluated by Akaike's automatic estimation procedure. The estimated values of Jury's stability parameters in each interval are quite scattered. It is shown, however, that the stability boundaries can be predicted by drawing a straight line as the upper side of an envelope for the scattering estimated values of the stability parameters. Author

N87-22170# National Aerospace Lab., Tokyo (Japan).
TWO-DIMENSIONAL ANALYSIS OF COANDA EFFECT IN IDEAL FLUID
Kingo Takasawa 1986 26 p In JAPANESE; ENGLISH summary
(NAL-TR-904; ISSN-0389-4010) Avail: NTIS HC A03/MF A01

The Coanda effect, or the phenomenon of a jet running along a curved wall is analyzed with a two-dimensional approach assuming an ideal fluid. A thick jet emerging from a nozzle with an arbitrary kick down angle is mainly concerned, relative to the upper-surface-blowing high lift concept. The result of the free stream line analysis of a jet running along an infinite plane wall is conformally transformed under the constraint of the conservation of the free stream line condition, and the Coanda flow along the curved wall is deduced. Not only the shape of the stream lines but also the flow velocity vector diagram and the wall pressure coefficient are calculated. The effect of the finiteness of a plane wall or the existence of the trailing edge of a wing/flap is also evaluated. Computation is executable with a 16-bit desk top computer, and programs written in the BASIC language are available. Author

N87-22171*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF COMMERCIAL FUEL CELL POWERPLANT SYSTEM DEVELOPMENT Final Report
Marvin Warshay 1987 8 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(Contract DE-AI21-80ET-17088)
(NASA-TM-89896; DOE/NASA/17088-5; E-3586; NAS 1.15:89896; AIAA-87-9081) Avail: NTIS HC A02/MF A01 CSCL 20D

The primary focus is on the development of commercial Phosphoric Acid Fuel Cell (PAFC) powerplant systems because the PAFC, which has undergone extensive development, is currently the closest fuel cell system to commercialization. Shorter discussions are included on the high temperature fuel cell systems which are not as mature in their development, such as the Molten Carbonate Fuel Cell (MCFC) and the Solid Oxide Fuel Cell (SOFC).

The alkaline and the Solid Polymer Electrolyte (SPE) fuel cell systems, are also included, but their discussions are limited to their prospects for commercial development. Currently, although the alkaline fuel cell continues to be used for important space applications there are no commercial development programs of significant size in the USA and only small efforts outside. The market place for fuel cells and the status of fuel cell programs in the USA receive extensive treatment. The fuel cell efforts outside the USA, especially the large Japanese programs, are also discussed. Author

N87-22172*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ARTIFICIAL DISSIPATION AND CENTRAL DIFFERENCE SCHEMES FOR THE EULER AND NAVIER-STOKES EQUATIONS Final Report
R. C. Swanson and Eli Turkel (Tel-Aviv Univ., Israel) Apr. 1987 55 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178296; ICASE-87-29; NAS 1.26:178296) Avail: NTIS HC A04/MF A01 CSCL 20D

An artificial dissipation model, including boundary treatment, that is employed in many central difference schemes for solving the Euler and Navier-Stokes equations is discussed. Modifications of this model such as the eigenvalue scaling suggested by upwind differencing are examined. Multistage time stepping schemes with and without a multigrid method are used to investigate the effects of changes in the dissipation model on accuracy and convergence. Improved accuracy for inviscid and viscous airfoil flow is obtained with the modified eigenvalue scaling. Slower convergence rates are experienced with the multigrid method using such scaling. The rate of convergence is improved by applying a dissipation scaling function that depends on mesh cell aspect ratio. Author

N87-22173# National Aeronautical Lab., Bangalore (India). Aerodynamics Div.
CONSTANT SOURCE PANEL METHOD FOR ANALYSIS OF POTENTIAL FLOW OVER ARBITRARY BODIES
H. N. V. Dutt and B. Rajeswari Aug. 1986 70 p
(TM-AE-8605) Avail: NTIS HC A04/MF A01

A computer code was developed for the calculation of potential flow about arbitrary bodies. The flow about the body is simulated by a source distribution on the surface. The body is represented by a set of flat panels and the source distribution on each panel is taken to be constant. Significant improvements were made in coding the method and these improvements are discussed. The results of the present code are compared with available experimental and theoretical results. Author

N87-22174*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELECTION OF HIGH TEMPERATURE THERMAL ENERGY STORAGE MATERIALS FOR ADVANCED SOLAR DYNAMIC SPACE POWER SYSTEMS
Dovie E. Lacy, Carolyn Coles-Hamilton, and Albert Juhasz 1987 13 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89886; E-3569; NAS 1.15:89886) Avail: NTIS HC A02/MF A01 CSCL 10B

Under the direction of NASA's Office of Aeronautics and Technology (OAST), the NASA Lewis Research Center has initiated an in-house thermal energy storage program to identify combinations of phase change thermal energy storage media for use with a Brayton and Stirling Advanced Solar Dynamic (ASD) space power system operating between 1070 and 1400 K. A study has been initiated to determine suitable combinations of thermal energy storage (TES) phase change materials (PCM) that result in the smallest and lightest weight ASD power system possible. To date the heats of fusion of several fluoride salt mixtures with melting points greater than 1025 K have been verified experimentally. The study has indicated that these salt systems produce large ASD systems because of their inherent low thermal conductivity and low density. It is desirable to have PCMs with high densities and high thermal conductivities. Therefore, alternate phase change materials based on metallic alloy systems are also being considered as possible TES candidates for future ASD space power systems. Author

N87-21928# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FUNDAMENTAL STUDIES ON SHOCK-WAVE/BOUNDARY-LAYER INTERACTIONS IN A 3-D CHANNEL
R. Benay, T. Pot, and J. Delery *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH; ENGLISH summary Original language document was announced in IAA as A87-21068 (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

N87-21933# Cambridge Univ. (England). Dept. of Engineering.
EXPERIMENTAL OBSERVATIONS ON AN UNSTEADY, NORMAL SHOCK/BOUNDARY LAYER INTERACTION
In AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 14 p (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

N87-21939# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NUMERICAL VISCOUS-INVISCID INTERACTION METHOD FOR INTERNAL SEPARATED FLOWS AND SHOCK WAVE-BOUNDARY LAYER INTERACTION
J. C. LeBalleur and D. Blaise *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH; ENGLISH summary (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

N87-21946# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
MODELING HIGH REYNOLDS NUMBER INTERNAL FLOWS BY NUMERICAL SOLUTION OF THE NAVIER-STOKES EQUATIONS [CALCUL D'ECOULEMENTS INTERNES A GRAND NOMBRE DE REYNOLDS PAR RESOLUTION NUMERIQUE DES EQUATIONS DE NAVIER-STOKES]
L. Cambier, B. Escande, and J.-P. Veuillot *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 20 p In FRENCH Original language document was announced in IAA as A87-21030 (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

N87-21948# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DETERMINATION OF THE SUPERSONIC CASCADE ENTRANCE ZONE [DETERMINATION DE LA REGION DE CAPATION D'UN GRILLE D'AUBES SUPERSONIQUE]
Georges Meauze *In* AGARD Transonic and Supersonic Phenomena in Turbomachines Mar. 1987 12 p In FRENCH; ENGLISH summary (For primary document see N87-21927 15-07)
Copyright Avail: NTIS HC A16/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N87-22175# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
PERFORMANCE OF A HADRON TEST CALORIMETER FOR THE ZEUS EXPERIMENT
J. Engelen, H. Tiecke, G. Dagostini, E. Bernardi, C. Daum, G. Drews, E. Hilger, R. Klanner, U. Koetz, J. Krueger (Hamburg Univ., West Germany) et al. 1986 19 p Presented at the 3rd Pisa Meeting on Advanced Detectors, Castiglione della Pescaia, Italy, 2-7 Jun. 1986
(NIKHEF-H/86-18; B8679705; ETN-87-99600) Avail: NTIS HC A02/MF A01

A depleted uranium (DU) scintillator hadron calorimeter was built as a first prototype for the ZEUS experiment. Tests with this calorimeter are part of a program to optimize several parameters, such as the DU and the scintillator thickness, in order to obtain the best energy resolution for hadrons and jets. Results obtained with 3.2 mm DU plates and 5 mm scintillator plates are for the hadron resolution 41.5%/root E and for the electron resolution 14.2%/root E, for beam momenta up to 9 GeV. Replacing the uranium by 4 mm thick lead plates, leads to a hadron resolution of 60%/root E, and an electron resolution of 13%/root E. ESA

N87-22176# Naval Research Lab., Washington, D. C.
EFFECT OF A.C. AND D.C. TRANSVERSE SELF FIELDS IN GYROTRONS Memorandum Report, Oct. 1984 - Sep. 1986
Thomas M. Antonsen, Wallace M. Manheimer, and Baruch Levush 31 Dec. 1986 52 p
(AD-A177418; NRL-MR-5882) Avail: NTIS HC A04/MF A01 CSCL 09A

The A.C. and D.C. transverse self fields are calculated in gyrotron oscillators. A slow time scale Hamiltonian formalism is developed and utilized. The principal effect of A.C. self fields is to couple electromagnetic and electrostatic effects so as to increase the growth rate. The main effect of D.C. self fields is to generate a spread in gyrofrequencies which tend to reduce efficiency. GRA

N87-22177# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CORRECTING ABERRATED WAVEFRONTS FROM SYNTHETIC APERTURES HOLOGRAPHICALLY M.S. Thesis
David A. Jacobs Dec. 1986 38 p
(AD-A177715; AFIT/GEP/ENP/86D-4) Avail: NTIS HC A03/MF A01 CSCL 20F

This thesis describes research to investigate how well holographic optical elements reduce abberations in synthetic aperture optical systems. Using holograms to correct aberrated wavefronts from synthetic apertures provides a viable alternative to using active control systems to perform the same function. The holographic technique has applications to the Strategic Defense Initiative, surveillance and reconnaissance systems, and high technology manufacturing processes. A model for a three-element synthetic aperture system was developed to determine how the wavefronts from the elements combine in the image plane. The model includes developing the technique for introducing a holographic optical element to correct aberrations from individual elements in the aperture and from misalignments in the system. Based on this model, a proof-of-concept system was developed. Finally, the results of experiments to evaluate the point spread function of the empirical system are described. The report concludes that holographic optical elements can provide an alternative to control systems when combined with synthetic apertures to replace monolithic optics in applications requiring diffraction limited imaging systems. GRA

N87-22178# Lawrence Livermore National Lab., Calif.
HYBRID CLOSED BOMB-STRAND BURNER FOR VERY HIGH PRESSURE BURNING RATE MEASUREMENTS
M. Costantino and D. Ornellas Oct. 1986 11 p Presented at the 23rd Joint Army Navy NASA Air Force Combustion Meeting (JANNAF), Hampton, Va., 20 Oct. 1986
(Contract W-7405-eng-48)
(DE87-001357; UCRL-94769; CONF-8610210-1) Avail: NTIS HC A02/MF A01

A hybrid closed bomb-strand burner is described that is suitable for burning rate measurements at pressures in excess of 1 GPa (150,000 PSI). The device is a cylindrical pressure vessel having an internal volume of about 50 cc and a means of extracting up to fifteen electrical or fiber optic signals. The sample is a right circular cylinder 6.35mm in diameter and 10 cm long with an epoxy coating on the outside surface as an inhibitor. The sample fits in a fixture which prevents its motion during the burn and provides mounting points for the diagnostics that detect the arrival of the burning surface. A variety of break wires and ionization probes to trigger the timing electronics have been used. At the burning rates of present interest (less than 1 m/s), the pressure was measured using an external load cell. An experiment consists of pre-pressurizing the vessel with argon, igniting the sample at one end, and measuring the pressure and the time of arrival at each probe. The average burning rate between wire locations n-1 and n, over the pressure range (P/sub n-1/,P/sub n/), is r/sub n-1,n/ = (x/sub n/-x/sub n-1/)/(t/sub n/-t/sub n-1/), giving a large portion of the burning rate-pressure curve in a single experiment. DOE

N87-22179*# United Technologies Research Center, East Hartford, Conn.
HIGH TEMPERATURE STATIC STRAIN GAGE ALLOY DEVELOPMENT PROGRAM Final Report
C. O. Hulse, R. S. Bailey, and F. D. Lemkey Mar. 1985 90 p
(Contract NAS3-23169)
(NASA-CR-174833; NAS 1.26:174833; R85-915952-13) Avail: NTIS HC A05/MF A01 CSCL 14B

The literature, applicable theory and finally an experimental program were used to identify new candidate alloy systems for use as the electrical resistance elements in static strain gages up to 1250K. The program goals were 50 hours of use in the environment of a test stand gas turbine engine with measurement accuracies equal to or better than 10 percent of full scale for strains up to + or - 2000 microstrain. As part of this effort, a computerized electrical resistance measurement system was constructed for use at temperatures between 300K and 1250K and heating and cooling rates of 250K/min and 10K/min. The two best alloys were an iron-chromium-aluminum alloy and a palladium base alloy. Although significant progress was made, it was concluded that a considerable additional effort would be needed to fully optimize and evaluate these candidate systems. Author

N87-22180*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IN-SITU TECHNIQUE FOR CHECKING THE CALIBRATION OF PLATINUM RESISTANCE THERMOMETERS
Kamran Daryabeigi and Lawrence A. Dillon-Townes May 1987 31 p
(NASA-TM-89146; NAS 1.15:89146) Avail: NTIS HC A03/MF A01 CSCL 14B

The applicability of the self-heating technique for checking the calibration of platinum resistance thermometers located inside wind tunnels was investigated. This technique is based on a steady state measurement of resistance increase versus joule heating. This method was found to be undesirable, mainly because of the fluctuations of flow variables during any wind tunnel testing. Author

N87-22181*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF A LIQUID-CRYSTAL, HEATER-ELEMENT COMPOSITE FOR QUANTITATIVE, HIGH-RESOLUTION HEAT TRANSFER COEFFICIENTS ON A TURBINE AIRFOIL, INCLUDING TURBULENCE AND SURFACE ROUGHNESS EFFECTS
Steven A. Hippensteele, Louis M. Russell, and Felix J. Torres May 1987 16 p Presented at the Winter Annual Meeting of the American Society of Mechanical Engineers, Anaheim, Calif., 7-12 Dec. 1986
(NASA-TM-87355; E-3021; NAS 1.15:87355) Avail: NTIS HC A02/MF A01 CSCL 14B

Local heat transfer coefficients were measured along the midchord of a three-times-size turbine vane airfoil in a static cascade operated at roon temperature over a range of Reynolds numbers. The test surface consisted of a composite of commercially available materials: a Mylar sheet with a layer of cholestric liquid crystals, which change color with temperature, and a heater made of a polyester sheet coated with vapor-deposited gold, which produces uniform heat flux. After the initial selection and calibration of the composite sheet, accurate, quantitative, and continuous heat transfer coefficients were mapped over the airfoil surface. Tests were conducted at two free-stream turbulence intensities: 0.6 percent, which is typical of wind tunnels; and 10 percent, which is typical of real engine conditions. In addition to a smooth airfoil, the effects of local leading-edge sand roughness were also examined for a value greater than the critical roughness. The local heat transfer coefficients are presented for both free-stream turbulence intensities for inlet Reynolds numbers from 1.20 to 5.55 x 10 to the 5th power. Comparisons are also made with analytical values of heat transfer coefficients obtained from the STAN5 boundary layer code. Author

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N87-22182# Minnesota Mining and Mfg. Co., St. Paul. Electronic and Information Sector Lab.
BLUE-GREEN LASER DIODE RESEARCH PROGRAM Quarterly Progress Report, 1 Oct. - 31 Dec. 1986 1986
T. L. Smith and C. T. Walker Jan. 1987 73 p
(Contract N00014-85-C-0552)
(AD-A176777; QPR-3) Avail: NTIS HC A04/MF A01 CSCL 20E

During this reporting period, efforts were begun to incorporate Na and N acceptors in ZnSe. Other efforts underway included studies of the efforts of growth rate on unintentionally-doped ZnSe, studies of the effectiveness of present substrate preparation procedures, studies of gain and dynamics in electron-beam-pumped lasing, Schottky and ohmic contact work, growth of ZnSe on Si using ZnSe/Ge superlattice buffer layers, and x-ray double crystal rocking curve comparative studies of the structure of ZnSe/GaAs and ZnSe/Ge. Significant progress was made in all of the above areas. GRA

N87-22183# Naval Postgraduate School, Monterey, Calif.
CO2 PULSED LASER DAMAGE MECHANISMS AND ASSESSMENT OF PLASMA EFFECTS (UNFOCUSED BEAM) M.S. Thesis
John S. Olson Dec. 1986 86 p
(AD-A176926) Avail: NTIS HC A05/MF A01 CSCL 20E

A theoretical study and experimental investigation of the plasma surface interactions and laser damage mechanisms associated with the irradiation of flat, cylindrical AISI SS 304 stainless steel targets was conducted. Two experiments were completed, one at normal atmospheric pressure and one in a high vacuum environment, using a Carbon Dioxide transversely excited atmospheric pressure (TEA), high energy, pulsed laser with an unfocused beam to ascertain the power density threshold requirements for plasma generation. Irradiated target specimens were thoroughly examined for evidence of surface damage with a scanning electron microscope capable of clearly displaying damage features of micron size dimensions. Experimental results confirmed that surface damage was confined solely to unipolar arcing for targets irradiated with power densities near the plasma formation thresholds. These thresholds were determined to be 0.88 Megawatts per square centimeter + or - 12% at atmospheric pressure and 0.43 Megawatts per square centimeter + or - 12% in the high vacuum. A Sequential Unipolar Arcing Model, which incorporated the elaborate details of the refined Schwirke Model, was developed to describe the complex series of interrelated events that constitute the unipolar arcing damage mechanism. The qualitative predictions of the theoretical model were confirmed by experimental results. GRA

N87-22184# Lawrence Livermore National Lab., Calif.
HIGH-AVERAGE-POWER SOLID-STATE GLASS LASER: DESIGN NOTES
W. L. Gagnon, M. A. Summers, and J. B. Trenholme Aug. 1986 208 p
(Contract W-7405-eng-48)
(DE87-005930; UCID-20921) Avail: NTIS HC A10/MF A01

This document is a compilation of engineering notes that describe the design basis for the components of a zig-zag laser experiment. Included are details of the glass-based laser cavity, design of the mirrors used, and an analysis of the cooling system requirements. Various electronic and electro-optical components are also described, such as laser flash tubes and pockels cell switches. The objective of this project is to demonstrate that the zig-zag geometry can be operated at the several hundred watt level with a near diffraction-limited beam. The design goals are an extracted energy of 150 J at a pulse width of 15 ns. DOE

N87-22185# California Univ., Berkeley. Lawrence Berkeley Lab.
BRIGHTNESS AND COHERENCE OF SYNCHROTRON RADIATION AND HIGH-GAIN FREE ELECTRON LASERS
K. J. Kim Oct. 1986 25 p Presented at the Brightness and Coherence of Synchrotron Radiation and High-gain Free Electron Lasers, Novosibirsk, USSR, 3 Jun. 1986
(Contract DE-AC03-76SF-00098)
(DE87-003525; LBL-22317; CONF-8606252-1) Avail: NTIS HC A02/MF A01

The characteristics of synchrotron radiation are reviewed with particular attention to its phase-space properties and coherence. The transition of the simple undulator radiation to more intense, more coherent high-gain free electron lasers, is discussed. DOE

N87-22186# University of Southern California, Los Angeles. Center for Laser Studies.
NEW, EFFICIENT OPTICALLY PUMPED SOLID STATE LASERS Annual Report, 15 Aug. 1985 - 14 Aug. 1986
Michael Bass and Milton Birnbaum 10 Dec. 1986 45 p
(Grant AF-AFOSR-0378-84)
(AD-A177296; AFOSR-87-0278TR) Avail: NTIS HC A03/MF A01 CSCL 20E

Several new results were reported. Of particular note was the demonstration of efficient laser operation of high dopant density Er: YAG at 2.94 um. This laser has valuable medical and other applications. Our work on radiation trapping in solids, while yielding interesting and useful spectroscopic results has thus far not fulfilled its earlier promise of potential utility in improving the efficiency of optically pumped solid state lasers. A paper detailing additional results of ruby fluorescence in the presence of strong R-line trapping is in preparation. A number of new studies were begun which have already yielded fruitful results. This is our work on the diode pumping of solid state laser. This field promises to be of considerable importance in the development of compact and efficient solid state lasers. The Optical Multichannel Analyzer has been completed and is now operational. It is expected to play an important role in our current investigations involving Er and Ho doped crystal lasers. Work has begun on research of the high dopant density Ho: YAG laser. GRA

N87-22187# Florida Univ., Gainesville. Space Astronomy Lab.
THE INTERACTION OF SMALL PARTICLES WITH LASER BEAMS: APPLICATION TO THE DEFENSE OF SATELLITES Final Report, 15 Jul. 1984 - 14 Nov. 1985
Nebil Y. Misconi and Keith F. Ratcliff 15 Sep. 1986 3 p
(Grant AF-AFOSR-0212-84)
(AD-A177330; AFOSR-87-0264TR) Avail: NTIS HC A02/MF A01 CSCL 20E

Equipment was acquired which is now the nucleus of a Laser Particle Dynamics Laboratory. This equipment is being used to measure transmission and subsequent beam suppression of laser light passing through layers of high purity silica particles. Using particle laser levitation techniques, this equipment will enable us to study laser induced particle dynamics under ambient pressure and in vacuum. A continuous wave argon laser (18 watt power) is used along with associated optics to carry out the investigation. A turbo molecular pump will be used in the vacuum mode of the experiment. Data acquisition is automated using a VME/10 microprocessor system. GRA

N87-22188# Schafer (W. J.) Associates, Inc., Chelmsford, Mass.
MULTIPLE COUPLED WAVEGUIDE LASER ARRAY Final Report, Jul. 1984 - Jun. 1986
Douglas G. Youmans 5 Nov. 1986 148 p
(Contract F33615-84-C-2445)
(AD-A177448; WJSA-FR-86-014; AFWAL-TR-86-2053) Avail: NTIS HC A07/MF A01 CSCL 20E

The purpose of this effort was to extend the principle of wavelength mode coupling previously established for two waveguides to a two dimensional array. In the theoretical portion of the program, two-dimensional array mode relative oscillator strengths (E-field distributions) were derived analytically for the first time. Fourier analysis of these array-modes indicated that almost an (nxm)2 increase (as for an array which is superimposed into one waveguide) in the far-field peak irradiance distribution would be achieved. The experimental program employed 1x7 and 2x3 arrays. Severe vacuum and materials problems were encountered with the 1x7 array. The 2x3 array achieved output powers of up to 8W per channel; on installation of ZnSe coupling windows the power decreased by an order of magnitude. Lasing could be achieved with all channels. No phase-locking was observed with either the 1x7 or 2x3 array for any of twenty different resonator configurations employed, including those using focussed and unfocussed grating. Folded resonator modes were found to dominate certain resonator configurations. GRA

N87-22189# Texas Univ., Dallas. Center for Quantum Electronics and Applications.
THE GAMMA-RAY LASER PROJECT: PROOF OF THE FEASIBILITY OF COHERENT AND INCOHERENT SCHEMES FOR PUMPING A GAMMA-RAY LASER Quarterly Technical Progress Report, 26 Sep. - 31 Dec. 1986
Carl B. Collins Jan. 1987 54 p
(Contract N00014-86-C-2488)
(AD-A177449; UTD-GRL-8601) Avail: NTIS HC A04/MF A01 CSCL 20E

Recent approaches to the problem of the gamma-ray laser have focused upon upconversion techniques in which metastable nuclei are pumped with long wavelength radiation. At the nuclear level the storage of energy can approach tera-Joules (10 to the 12th power J) per liter for thousands of years. However, any plan to use such a resource for a gamma-ray laser poses problems of a broad interdisciplinary nature requiring the fusion of concepts taken from relatively unrelated fields of physics. Since 1978 we have pursued an approach for the upconversion of longer wavelength radiation incident upon isomeric nuclear populations that can avoid many of the difficulties encountered with traditional concepts of single photon pumping. Recent experiments have confirmed the general feasibility and have indicated that a gamma-ray laser is feasible if the right combination of energy levels and branching ratios exists in some real material. Resolution of the question of the feasibility of a gamma-ray laser now rests upon the determination of: (1) the identity of the best candidate, (2) the threshold level of laser output, and (3) the upconversion driver for that material. GRA

N87-22190# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SUITABILITY AND APPLICATIONS OF LIQUID CRYSTAL TELEVISIONS IN OPTICAL PRE-PROCESSORS M.S. Thesis
Kenneth D. Hughes Dec. 1986 88 p
(AD-A177603; AFIT/GE/ENG/86D-6) Avail: NTIS HC A05/MF A01 CSCL 17B

The suitability of a low-cost liquid crystal television to function as a spatial light modulator for lasers is investigated along with the possibility of using such a modulator in an optical pre-processor for an electronic pattern recognition system. The particular pre-processor application investigated is that of optically enhancing the edges of an image. It was determined that the liquid crystal television could perform reasonably well as a spatial light modulator for applications where very high image quality was not required. Three different methods were found to produce recognizable edges of a given image: spatial filtering in the Fourier plane, image cancellation, and phase cancellation. The phase cancellation method was discovered during the course of the research. These methods were able to perform the edge enhancement task whether the image was binary as in a computer generated image, or was continuous as from a television camera. GRA

N87-22191# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LASER INDUCED DAMAGE AT 1.06 MICRONS OF TITANIUM OXIDE THIN FILMS DEPOSITED BY THE SOL-GEL PROCESS M.S. Thesis
Thomas E. McNeil Dec. 1986 100 p
(AD-A177657; AFIT/GEP/ENP/86D-7) Avail: NTIS HC A05/MF A01 CSCL 11C

Pulsed laser-induced damage, at 1.06 microns, of titanium oxide interference coatings was studied. Coatings were applied to silicon wafers by a solvent evaporation (sol-gel) process. Trends in the laser-induced damage threshold as a function of process parameters and coatings properties were observed. Baking temperature and coating thickness were identified as key factors to be controlled in producing high laser damage threshold coatings. Microscopy and helium-neon scattering were compared as damage detection methods. The sensitivity of the two-methods were found to be equivalent. However, helium-neon scattering was found to be superior. The speed and automated data reduction capabilities of the computer-controlled scatterometer made it suitable for large optics and high-volume applications. GRA

N87-22192# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FREQUENCY STABILIZATION OF A HELIUM-NEON LASER TO A HIGH-FINESSE RING CAVITY M.S. Thesis
Alan H. Ratcliff Dec. 1986 78 p
(AD-A177741; AD-E751201; AFIT/GE/ENG/86D-47) Avail: NTIS HC A05/MF A01 CSCL 20E

Research is ongoing to develop a passive Ring Laser Gyroscope (RLG) capable of detecting rotation rates on the order of 10 to the 7th to the 10 to the 10th power of the earth's rotation rate. To obtain such sensitivity, a large high finesse resonant cavity is required. Using a high finesse cavity in a passive RLG configuration leaves the stability of the source laser as the limiting factor of performance. Recent experiments have demonstrated the ability to narrow the laser linewidth by locking the laser frequency to a high finesse cavity via feedback control to the source laser from the cavity in resonance. In this experiment, techniques were implemented to further reduce the linewidth of a Helium neon laser locked to a 25,000 finesse ring cavity. Results indicate that the sensitivity of a passive RLG with these modifications would improve through an increased signal to noise ratio. . GRA

N87-22193# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TARGET RECOGNITION USING THREE DIMENSIONAL LASER RANGE IMAGERY M.S. Thesis
Richard P. DeFatta Dec. 1986 86 p
(AD-A177755; AFIT/GEP/ENP/86D-2) Avail: NTIS HC A05/MF A01 CSCL 17I

This thesis involved the analysis of computer generated synthetic range imagery for the purpose of autonomous target recognition. The scenario is an air to surface missile sensor using a laser rangefinder to image prospective targets and attempt recognition. Synthetic range images of a sophisticated Soviet T 72 tank model were created. Cross correlation was used as a recognition technique. A reference tank image was tested against rotated images and an array of decoys. The reference image was analyzed for its most prominent features for the purpose of examining feature extraction as a recognition technique. Two methods of image enhancement were compared: gradient (frequency emphasis) and phase only filtering. It was shown that these two methods exhibited equal performance for recognition of rotated targets, but differently in decoy rejection. Phase only filtering was more effective in the process of discriminating simple decoys from actual tanks. Feature analysis of the model tank revealed its correlation was highly dependent upon what method of image enhancement was used. GRA

N87-22194# Aerospace Corp., El Segundo, Calif. Space Systems Div.
LASER DOPPLER VELOCIMETRY
Charles P. Wang 14 Oct. 1986 38 p
(Contract F04701-85-C-0086)
(AD-A177833; TR0086(6761)-1; SD-TR-87-06) Avail: NTIS HC A03/MF A01 CSCL 17E

Because it uses light scattering, Doppler shift, and optical heterodyne, laser Doppler velocimetry is an extremely powerful diagnostic technique for the measurement of flow velocity components. Its basic principles, optical arrangements, signal processing techniques, and applications are discussed as well as its advantages, disadvantages, and applications in the study of fluid mechanics. GRA

N87-22195# Institut Francais du Petrole, Paris (France).
INTERACTION OF REPETITIVELY PULSED HIGH ENERGY LASER RADIATION WITH MATTER
M. Hugenschmidt 29 May 1986 10 p Presented at the 3rd International Symposium on Optical and Optoelectronic Applied Sciences and Engineering. Session on High-Power Lasers and their Industrial Applications, Innsbruck, Austria, 14-18 Apr. 1986
(ISL-CO-216/86; ETN-87-99636) Avail: NTIS HC A02/MF A01

Laser target interaction processes and methods of improving the overall energy balance are discussed. This can be achieved with high repetition rate pulsed lasers even for initially highly reflecting materials, such as metals. Experiments were performed using a pulsed CO2 laser at mean powers up to 2 KW and repetition rates up to 100 Hz. The rates of temperature rise of aluminum for example are increased by more than a factor of 3 as compared to cw-radiation of comparable power density. Similar improvements are found for the overall absorptivities, that are increased by more than an order of magnitude. ESA

N87-22196# Tennessee Univ. Space Inst., Tullahoma.
EVALUATION OF THE LASER DOPPLER VELOCIMETER FOR PARTICLE SIZING
T. V. Giel, Jr. and J. Y. Son Jan. 1987 50 p
(Contract DE-AC21-85MC-22184)
(DE87-001069; DOE/MC-22184/2280) Avail: NTIS HC A03/MF A01

Measurement techniques for in-situ simultaneous measurements of particle size distributions and particle velocities using the dual beam laser Doppler velocimeter (LV) were investigated. The different signal characteristics of the LV for extraction of both particle size and particle velocity were examined. These signal components were evaluated not only singularly but also as sets of multiple simultaneous measurements to determine which characteristic, or combination of characteristics, provides the best measure of particle size. Different components of the LV signal were considered, but analysis concentrated on Doppler phase angle, visibility, and scatter-intensity because they show the greatest promise. Because LV signal characteristics are not monotonic functions of the particle size parameter, the resulting uncertainties introduced in the size-signal relationship were identified for the signals for both separate and simultaneous measurements. Uncertainties introduced by multiple particle indices of refraction were also evaluated. Finally, uncertainties resulting from particle trajectory variations in the spatially nonuniform LV probe volume were considered. No one signal characteristic or optical configuration was found which would minimize all uncertainties, but optimal configurations were identified for selected applications. Experimental verification and further optimization are recommended. The most promising instrument should be designed and tested to perform this validation, while allowing experimental comparisons of possible instrument configurations and developing instrument design concepts. DOE

N87-22197# Illinois Univ., Chicago. Dept. of Physics.
MULTIPHOTON IONIZATION IN INTENSE ULTRAVIOLET LASER FIELDS
U. Johann, T. S. Luk, I. A. McIntyre, A. McPherson, A. P. Schwarzenbach, K. Boyer, and C. K. Rhodes Mar. 1986 12 p Presented at the Topical Meeting on Short Wave Length Coherent Radiation, Monterey, Calif., 24 Mar. 1986
(Contract DE-AC02-83ER-13137)
(DE87-004729; CONF-860316-13) Avail: NTIS HC A02/MF A01

The mechanism of collision-free multiphoton ionization of rare gases irradiated with ultraviolet radiation at an intensity of up to approx. 10 to the 16th power W/sq cm at 248 nm and a pulse length of approx. 0.5 ps and approx. 10 to the 15th power W/sq cm at 193 nm and approx. 5ps, respectively, has been studied by observing the electron energy spectra and ion charge state threshold intensities. The formation of multiply charged ions by a sequential process of ionization has been directly detected in the electron energy spectra in the form of a characterisitic pattern of interwoven above threshold ionization (ATI) ladder line series. The threshold intensities for ion production have been compared with the Keldysh model and were found to be in good agreement for light ions (Ne) and consistently lower for heavier ions (Xe), scaling with the atomic number. These measurements, together with estimates of the ion population dynamics during the rise of the laser pulse can be reasonably understood on the basis of a single electron picture. DOE

N87-22198# Allied Corp., Morristown, N.J.
NEW LASER MATERIALS Final Report, Jan. - Dec. 1985
Sep. 1986 85 p Prepared in cooperation with Lawrence Livermore National Lab., Calif.
(Contract W-7405-eng-48)
(DE87-006722; UCRL-15867-Vol-1) Avail: NTIS HC A05/MF A01

The work during the contract year can be roughly divided into three phases: The initial phase involved the re-evaluation of a list of compounds synthesized at Allied prior to the present contract. A list of such compounds was included in the first interim report (February to April 1985). Candidates identified as potential laser materials were further investigated. Iso-structures of some known compounds were also grown and studied in the second phase. These compounds included LaScO3, Mg2SiO4 (forsterite), ZnGa2O4, CdGa2O4 and Ga2(WO4)3. The third phase consisted of the synthesis of new materials. A notable example is Cr doped ScBO3, the first reported borate crystal tunable laser host. Room temperature tunable laser action was demonstrated. Other new materials investigated include InBO3, YBO3, NaAlP2O7 and CaAl2O4. The following report consists of two main sections, spectroscopy and materials synthesis. DOE

N87-22283# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE RESULT OF THE CO-LOCATION IN WETTZELL (WEST GERMANY) [DIE ERGEBNISSE DER KOLLOCATION IN WETTZELL]
Hermann Hauck *In its* Repts. on Cartography and Geodesy, Series 1, No. 96 1985 p 5-13 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22282 15-43)
Avail: NTIS HC A03/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N87-22199*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTORDYNAMIC INSTABILITY PROBLEMS IN HIGH-PERFORMANCE TURBOMACHINERY, 1986
Jan. 1987 548 p Workshop held in College Station, Tex., 2-4 Jun. 1986; sponsored in cooperation with Texas A&M Univ., Army Research Office, and Air Force Aeropropulsion Lab.
(NASA-CP-2443; E-3136; NAS 1.55:2443) Avail: NTIS HC A23/MF A01 CSCL 13I

The first rotordynamics workshop proceedings (NASA CP-2133, 1980) emphasized a feeling of uncertainty in predicting the stability of characteristics of high-performance turbomachinery. In the second workshop proceedings (NASA CP-2250, 1982) these uncertainities were reduced through programs established to systematically resolve problems, with emphasis on experimental validiation of the forces that influence rotordynamics. In third proceedings (NASA CP-2338, 1984) many programs for predicting or measuring forces and force coefficients in high-performance turbomachinery produced results. Data became available for designing new machines with enhanced stability characteristics or for upgrading existing machines. The present workshop proceedings illustrates a continued trend toward a more unified view of rotordynamic instability problems and several encouraging new analytical developments. For individual titles, see N87-22200 through N87-22227.

N87-22200*# Dresser Industries, Inc., Olean, N.Y.
A HISTORY OF DEVELOPMENT IN ROTORDYNAMICS: A MANUFACTURER'S PERSPECTIVE
David E. Shemeld *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 1-18 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The subject of rotordynamics and instability problems in high performance turbomachinery has been a topic of considerable industry discussion and debate over the last 15 or so years. This paper reviews an original equipment manufacturer's history of development of concepts and equipment as applicable to multistage centrifugal compressors. The variety of industry user compression requirements and resultant problematical situations tends to confound many of the theories and analytical techniques set forth. The experiences and examples described herein support the conclusion that the successful addressing of potential rotordynamics problems is best served by a fundamental knowledge of the specific equipment. This in addition to having the appropriate analytical tools. Also, that the final proof is in the doing. Author

N87-22201*# Solar Turbines International, San Diego, Calif.
AN EXAMINATION OF GAS COMPRESSOR STABILITY AND ROTATING STALL
Aziz A. Fozi *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 19-33 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The principal sources of vibration related reliability problems in high pressure centrifugal gas compressors are the re-excitation of the first critical speed or Resonant Subsynchronous Vibration (RSSV), and the forced vibration due to rotating stall in the vaneless diffusers downstream of the impellers. An example of such field problems is given elsewhere. This paper describes the results of a test program at the author's company, initiated in 1983 and completed during 1985, which studied the RSSV threshold and the rotating stall phenomenon in a high pressure gas compressor. Author

N87-22202*# Exxon Research and Engineering Co., Florham Park, N.J.
SUBSYCHRONOUS VIBRATION OF MULTISTAGE CENTRIFUGAL COMPRESSORS FORCED BY ROTATING STALL
J. W. Fulton *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 35-62 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

A multistage centrifugal compressor, in natural gas re-injection service on an offshore petroleum production platform, experienced subsynchronous vibrations which caused excessive bearing wear. Field performance testing correlated the subsynchronous amplitude with the discharge flow coefficient, demonstrating the excitation to be aerodynamic. Adding two impellers allowed an increase in the diffuser flow angle (with respect to tangential) to meet the diffuser stability criteria based on factory and field tests correlated using the theory of Senoo (for rotating stall in a vaneless diffuser). This modification eliminated all significant subsynchronous vibrations in field service, thus confirming the correctness of the solution. Other possible sources of aerodynamically induced vibrations were considered, but the judgment that those are unlikely has been confirmed by subsequent experience with other similar compressors. Author

N87-22203*# Hangzhou Steam Turbine Works (China).
INSTABILITY OF MULTISTAGE COMPRESSOR K1501
Ren-mu Zhou *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 63-75 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The K1501 compressor, driven by a steam turbine, is used to transport synthetic gas in fertilizer plants of 1000 tons daily production. The turbo-compressor set, which had been in operation since 1982, vibrated rather intensely, and its maximum load was only about 95 percent of the normal value. Damaging vibration to pads and gas-sealing labyrinths occurred three times from 1982 to 1983 and resulted in considerable economic loss. From the characteristics of the vibration, we suspected its cause to be rotor instability due to labyrinth-seal excitation. But, for lack of experience, the problem was not addressed for two years. Finally, we determined that the instability was indeed produced by labyrinth-seal excitation and corrected this problem by injecting gas into the middle-diaphragm labyrinths. This paper primarily discusses the failure and the remedy described above. Author

N87-22204*# Kaiserslautern Univ. (West Germany).
CALCULATING ROTORDYNAMIC COEFFICIENTS OF SEALS BY FINITE-DIFFERENCE TECHNIQUES
F. J. Dietzen and R. Nordmann *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 77-98 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

For modelling the turbulent flow in a seal the Navier-Stokes equations in connection with a turbulence (kappa-epsilon) model are solved by a finite-difference method. A motion of the shaft round the centered position is assumed. After calculating the corresponding flow field and the pressure distribution, the rotor-dynamic coefficients of the seal can be determined. These

coefficients are compared with results obtained by using the bulk flow theory of Childs and with experimental results. Author

N87-22205*# Kobe Univ. (Japan).
STATIC AND DYNAMIC CHARACTERISTICS OF PARALLEL-GROOVED SEALS
Takuzo Iwatsubo, Bo-suk Yang, and Ryuji Ibaraki (Toyota Motor Co., Tokyo, Japan) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 99-127 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Presented is an analytical method to determine static and dynamic characteristics of annular parallel-grooved seals. The governing equations were derived by using the turbulent lubrication theory based on the law of fluid friction. Linear zero- and first-order perturbation equations of the governing equations were developed, and these equations were analytically investigated to obtain the reaction force of the seals. An analysis is presented that calculates the leakage flow rate, the torque loss, and the rotordynamic coefficients for parallel-grooved seals. To demonstrate this analysis, we show the effect of changing number of stages, land and groove width, and inlet swirl on stability of the boiler feed water pump seals. Generally, as the number of stages increased or the grooves became wider, the leakage flow rate and rotor-dynamic coefficients decreased and the torque loss increased. Author

N87-22206*# Kaiserslautern Univ. (West Germany).
ROTORDYNAMIC COEFFICIENTS AND LEAKAGE FLOW OF PARALLEL GROOVED SEALS AND SMOOTH SEALS
R. Nordmann, F. J. Dietzen, W. Janson, A. Frei, and S. Florjancic (Sulzer Bros. Ltd., Winterthur, Switzerland) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 129-153 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Based on Childs finite length solution for annular plain seals an extension of the bulk flow theory is derived to calculate the rotordynamic coefficients and the leakage flow of seals with parallel grooves in the stator. Hirs turbulent lubricant equations are modified to account for the different friction factors in circumferential and axial direction. Furthermore an average groove depth is introduced to consider the additional circumferential flow in the grooves. Theoretical and experimental results are compared for the smooth constant clearance seal and the corresponding seal with parallel grooves. Compared to the smooth seal the direct and cross-coupled stiffness coefficients as well as the direct damping coefficients are lower in the grooved seal configuration. Leakage is reduced by the grooving pattern. Author

N87-22207*# Kobe Univ. (Japan).
THEORETICAL APPROACH TO OBTAINING DYNAMIC CHARACTERISTICS OF NONCONTACTING SPIRAL-GROOVED SEALS
Takuzo Iwatsubo, Bo-suk Yang, and Ryuji Ibaraki (Toyota Motor Co., Tokyo, Japan) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 155-188 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The dynamic characteristics of spiral-grooved seals are theoretically obtained by using the Navier-Stokes equation. First, with the inertia term of the fluid considered, the flow and pressure in the steady state are obtained for the directions parallel to and perpendicular to the groove. Next, the dynamic character is obtained by analyzing the steady state and by analyzing the labyrinth seal. As a result, the following conclusions were drawn: (1) As the land width becomes shorter or the helix angle decreases, the cross-coupling stiffness, direct and cross-coupling damping, and add mass coefficients decrease; (2) As the axial Reynolds number increases, the stiffness and damping coefficients increase. But the add mass coefficient is not influenced by the axial Reynolds number; (3) The rotational Reynolds number influences greatly the direct and cross-coupling stiffness and direct damping coefficients; and (4) As the journal rotating frequency increases, the leakage flow decreases. Therefore zero net leakage flow is possible at a particular rotating frequency. Author

N87-22208*# Texas A&M Univ., College Station.
COMPARISON OF HIRS' EQUATION OF MOODY'S EQUATION FOR DETERMINING ROTORDYNAMIC COEFFICIENTS OF ANNULAR PRESSURE SEALS
Clayton C. Nelson and Dung T. Nguyen *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 189-203 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The rotordynamic coefficients of an incompressible-flow annular pressure seal were determined using a bulk-flow model in conjunction with two different friction factor relationships. The first, Hirs' equation, assumes the friction factor is a function of Reynolds number only. The second, Moody's equation, approximates Moody's diagram and assumes the friction factor is a function of both Reynolds number and relative roughness. For each value of relative roughness, Hirs' constants were determined so that both equations gave the same magnitude and slope of the friction factor. For smooth seals, both relationships give the same results. For rough seals (e/2 H sub 0 = 0.05) Moody's equation predicts 44% greater direct stiffness, 35% greater cross-coupled stiffness, 19% smaller cross-coupled damping, 59% smaller cross-coupled inertia, and nominally the same direct damping and direct inertia. Author

N87-22209*# Mitsubishi Heavy-Industries Ltd., Takasago (Japan).
DESTABILIZING FORCE OF LABYRINTH SEAL
Hiroshi Kanki and Shigeki Morit (Mitsubishi Heavy Industries Ltd., Hiroshima, Japan) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 205-223 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

A great deal of research has recently been conducted to solve the subsynchronous rotor vibration problems in high-performance turbomachinery. Particularly, the destabilizing effect of the labyrinth seal on compressors or turbines has been investigated for many years. In spite of many efforts the dynamic effect of the labyrinth seal had not been fully determined from qualitative and quantitative points of view. But from theoretical and experimental work, the dynamic characteristics of the labyrinth seal have been established. The results of recent theoretical and experimental works are presented. Author

N87-22210*# Virginia Polytechnic Inst. and State Univ., Blacksburg.
INFLUENCE OF DISK LEAKAGE PATH ON LABYRINTH SEAL INLET SWIRL RATIO
R. Gordon Kirk *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 225-236 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The results of numerous investigators have shown the importance of labyrinth seal inlet swirl on the calculated dynamic stiffness of labyrinth seals. These results have not included any calculation of inlet leakage swirl as a function of geometry and sealing conditions of the given seal. This paper outlines a method of calculating the inlet swirl at a given seal by introducing a radial chamber to predict the gas swirl as it goes from the stage tip down to the seal location. For a centrifugal compressor, this amounts to including the flow path from the impeller discharge, down the back of the disk or front of the cover, then into the shaft seal or eye packing, respectively. The solution includes the friction factors of both the disk and stationary wall with account for mass flow rate and calculation of radial pressure gradients by a free vortex solution. The results of various configurations are

discussed and comparisons made to other published results of disk swirl. Author

N87-22211*# Sulzer-Escher Wyss Ltd., Zurich (Switzerland).
THEORY AND MEASUREMENTS OF LABYRINTH SEAL COEFFICIENTS FOR ROTOR STABILITY OF TURBOCOMPRESSORS
H. R. Syssmann *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 237-258 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The prediction of rotordynamic coefficients for gas seals is achieved with the aid of a two-volume bulk flow model based on turbulent rotationally symmetric 3D flow calculations including swirl flow. Comparison of cross-coupling and damping coefficients with measurements confirm this approach. In particular the theoretically predicted phenomenon that labyrinth damping is retained without inlet swirl is confirmed. This is important for the design of high pressure compressors, where labyrinth damping is a major contribution improving rotor stability. Discrepancies are found when comparing theory with measured direct stiffness and the cross-coupling damping coefficients. First measurements of labyrinth seals on a recently installed test rig operated with water are presented. Since forces are larger than on test stands operated with air and since individual chamber forces are obtained phenomena like inlet effects may be studied. Author

N87-22212*# Texas A&M Univ., College Station.
EXPERIMENTAL ROTORDYNAMIC COEFFICIENT RESULTS FOR TEETH-ON-ROTOR AND TEETH-ON-STATOR LABYRINTH GAS SEALS
Dara W. Childs and Joseph K. Scharrer *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 259-275 (For primary document see N87-22199 15-37)
(Contract NAS3-181; Grant F49620-82-K-0033)
Avail: NTIS HC A23/MF A01 CSCL 13I

An experimental test facility is used to measure the rotordynamic coefficients of teeth-on-rotor and teeth-on-stator labyrinth gas seals. Direct damping coefficients are presented for these seals for the first time. The results are presented for the two seal configurations at identical operating conditions, and show that, in a rotordynamic sense, the teeth-on-stator seal is more stable than the teeth-on-rotor seal, for inlet tangential velocity in the direction of rotation. Author

N87-22213*# Liverpool Univ. (England).
NON-LINEAR IDENTIFICATION OF A SQUEEZE-FILM DAMPER
Roger Stanway, John Mottershead, and Riaz Firoozian *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 277-291 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Described is an experimental study to identify the damping laws associated with a squeeze-film vibration damper. This is achieved by using a non-linear filtering algorithm to process displacement responses of the damper ring to synchronous excitation and thus to estimate the parameters in an nth-power velocity model. The experimental facility is described in detail and a representative selection of results is included. The identified models are validated through the prediction of damper-ring orbits and comparison with observed responses. Author

N87-22214*# Sussex Univ., Brighton (England).
ESTIMATION OF SQUEEZE-FILM DAMPING AND INERTIAL COEFFICIENTS FROM EXPERIMENTAL FREE-DECAY DATA
J. B. Roberts, R. Holmes, and P. J. Mason (Chelsea Coll. of Aeronautical and Automobile Engineering, Shoreham, England) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 293-314 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The results are given for an experimental program concerned with a parametric identification of the damping and inertial coefficients of a cylindrical squeeze-film bearing, through an analysis of transient response data. The results enable the operating range for which a linear model of the squeeze-film is appropriate to be determined. Comparisons are made between the estimated coefficients and theoretical predictions. Presentation is by courtesy of the Council of the Institution of Mechanical Engineers, London. Author

N87-22215*# Garrett Corp., Phoenix, Ariz.
INSTABILITY OF AN INTERSHAFT SQUEEZE FILM DAMPER IN A TWO-SPOOL ROTOR DYNAMICS SIMULATOR
R. G. Alderson *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 315-323 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

An instability associated with an intershaft squeeze film damper is described. The squeeze film is located between the intershaft bearing outer race and the low-speed shaft of a five-bearing, two-spool test rig. The instability is dominated by response of the third system mode to destabilizing excitation of the type described by Hibner, et al. Installing a spring cage in place of the intershaft damper removes the instability and produces satisfactory performance throughout the operating range. Author

N87-22216*# Heriot-Watt Univ., Edinburgh (Scotland).
A NOVEL FORM OF DAMPER FOR TURBO-MACHINERY
R. D. Brown and J. A. Hart *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 325-347 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Anti-swirl vanes are used by some manufacturers to delay the full development of half speed circulation in annular clearance spaces. The objective is to reduce the aerodynamic cross-coupling in the forward direction. The novel feature of a jet damper is a number of tangential nozzles discharging against the rotor surface speed. Some preliminary results on a 33.9 Kg rotor demonstrate that significant reductions in amplitude are obtained at the synchronous critical speeds. Author

N87-22217*# Southampton Univ. (England).
NON-LINEAR PERFORMANCE OF A THREE-BEARING ROTOR INCORPORATING A SQUEEZE-FILM DAMPER
R. Holmes and M. Dede *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 349-364 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

This paper is concerned with the non-linear vibration performance of a rigid rotor supported on three bearings, one being surrounded by a squeeze-film damper. This damper relies on the pressure built up in the squeeze film to help counter-act external forces arising from unbalance and other effects. As a result a vibration orbit of a certain magnetude results. Such vibration orbits illustrate features found in other non-linear systems, in particular sub-harmonic resonances and jump phenomena. Comparisons between theoretical prediction and experimental observations of these phenomena are made. Author

N87-22218*# Strathclyde Univ., Glasgow (Scotland).
DYNAMIC PERFORMANCE OF SQUEEZE-FILM BEARINGS
C. R. Burrow, M. N. Sahinkaya, N. C. Kucuk, and D. Taylor (Cornell Univ., Ithaca, N.Y.) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 365-372 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Earlier work has shown that oil-film forces can be modelled by linear coefficients. Identification techniques were used to generate numerical values for these coefficients. This paper has shown the

invalidity of applying the perturbation techniques normally used in bearing studies to derive expressions for linearized coefficients to represent a cavitated oil-film. An alternative approach was developed based upon energy techniques to obtain estimates for linearized coefficients. Some current work being undertaken suggests that an alternative analytical approach is possible. These results will be reported in due course. Author

N87-22219*# Texas A&M Univ., College Station.
EXPERIMENTAL MEASUREMENT OF THE DYNAMIC PRESSURE DISTRIBUTION IN A SQUEEZE FILM BEARING DAMPER EXECUTING CIRCULAR CENTERED ORBITS
L. A. SanAndres and J. M. Vance *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 373-396 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

A review of previous experimental measurements of squeeze film damper (SFD) forces is given. Measurements by the authors of SFD pressure fields and force coefficients, for circular centered orbits with epsilon = 0.5, are described and compared with computer predictions. For Reynolds numbers over the range 2-6, the effect of fluid inertia on the pressure fields and forces is found to be significant. Author

N87-22220*# Cornell Univ., Ithaca, N.Y.
NONLINEAR DYNAMICS OF ATTRACTIVE MAGNETIC BEARINGS
K. V. Hebbale and D. L. Taylor *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 397-418 (For primary document see N87-22199 15-37)
(Contract N00014-80-C-0618)
Avail: NTIS HC A23/MF A01 CSCL 13I

The nonlinear dynamics of a ferromagnetic shaft suspended by the force of attraction of 1, 2, or 4 independent electromagnets is presented. Each model includes a state variable feedback controller which has been designed using the pole placement method. The constitutive relationships for the magnets are derived analytically from magnetic circuit theory, and the effects of induced eddy currents due to the rotation of the journal are included using Maxwell's field relations. A rotor suspended by four electro-magnets with closed loop feedback is shown to have nine equilibrium points within the bearing clearance space. As the rotor spin speed increases, the system is shown to pass through a Hopf bifurcation (a flutter instability). Using center manifold theory, this bifurcation can be shown to be of the subcritical type, indicating an unstable limit cycle below the critical speed. The bearing is very sensitive to initial conditions, and the equilibrium position is easily upset by transient excitation. The results are confirmed by numerical simulation. Author

N87-22221*# Virginia Univ., Charlottesville.
DYNAMICS OF A FLEXIBLE ROTOR IN MAGNETIC BEARINGS
P. E. Allaire, R. R. Humphris, and R. D. Kelm (Dow Chemical Co., Houston, Tex.) *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 419-430 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Discussed is a magnetic bearing which was designed and tested in a flexible rotor both as support bearings and as a vibration controller. The design of the bearing is described and the effect of control circuit bandwidth determined. Both stiffness and damping coefficients were measured and calculated for the bearing with good agreement. The bearings were then placed in a single mass rotor as support bearings and the machine run through two critical speeds. Measurements were made of the vibration response in plain bushings and magnetic bearings. Comparisons were also made of the theoretical calculations with the measured peak unbalance response speeds. Finally, runs were made with the magnetic bearing used as a vibration controller. Author

N87-22222*# Sussex Univ., Brighton (England).
PERFORMANCE OF AN ELECTROMAGNETIC BEARING FOR THE VIBRATION CONTROL OF A SUPERCRITICAL SHAFT
C. D. Bradfield, J. B. Roberts, and R. Karunendiran *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 431-460 Sponsored in part by Science and Engineering Research Council, England (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

The flexural vibrations of a rotating shaft, running through one or more critical speeds, can be reduced to an acceptably low level by applying suitable control forces at an intermediate span position. If electromagnets are used to produce the control forces then it is possible to implement a wide variety of control strategies. A test rig is described which includes a microprocessor-based controller, in which such strategies can be realised in terms of software-based algorithms. The electromagnet configuration and the method of stabilising the electromagnet force-gap characteristic are discussed. The bounds on the performance of the system are defined. A simple control algorithm is outlined, where the control forces are proportional to the measured displacement and velocity at a single point on the shaft span; in this case the electromagnet behaves in a similar manner to that of a parallel combination of a linear spring and damper. Experimental and predicted performance of the system are compared, for this type of control, where various programmable rates of damping are applied. Author

N87-22223*# Texas A&M Univ., College Station.
A MAGNETIC BEARING BASED ON EDDY-CURRENT REPULSION
J. L. Nikolajsen *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 461-466 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

This paper describes a new type of electromagnetic bearing, called the Eddy-Current Bearing, which works by repulsion between fixed AC-electromagnets and a conducting rotor. The following advantages are expected: inherent stability, higher load carrying capacity than DC-electromagnetic bearings, simultaneous radial, angular and thrust support, motoring and generating capability, and backup mode of operation in case of primary power failure. A prototype is under construction. Author

N87-22224*# California Inst. of Tech., Pasadena.
ORIGINS OF HYDRODYNAMIC FORCES ON CENTRIFUGAL PUMP IMPELLERS
Douglas R. Adkins and Christopher E. Brennen *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 467-491 Sponsored in part by Shell Companies Foundation (For primary document see N87-22199 15-37)
(Contract NAS8-33108)
Avail: NTIS HC A23/MF A01 CSCL 13I

Hydrodynamic interactions that occur between a centrifugal pump impeller and volute are experimentally and theoretically investigated. The theoretical analysis considers the inability of the blades to perfectly guide the flow through the impeller, and also includes a quasi-one dimensional treatment of the flow in the volute. The disturbance at the impeller discharge and the resulting forces are determined by the theoretical model. The model is then extended to obtain the hydrodynamic force perturbations that are caused by the impeller whirling eccentrically in the volute. Under many operating conditions, these force perturbations were found to be destablizing. Comparisons are made between the theoretical model and the experimental measurements of pressure distributions and radial forces on the impeller. The theoretical model yields fairly accurate predictions of the radial forces caused by the flow through the impeller. However, it was found that the pressure acting on the front shroud of the impeller has a substantial effect on the destablizing hydrodynamic forces. Author

N87-22225*# California Inst. of Tech., Pasadena.
ON THE EFFECT OF CAVITATION ON THE RADIAL FORCES AND HYDRODYNAMIC STIFFNESS OF A CENTRIFUGAL PUMP
R. J. Franz, C. E. Brennen, A. J. Acosta, and T. K. Caughey *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 493-501 (For primary document see N87-22199 15-37)
(Contract NAS8-33108)
Avail: NTIS HC A23/MF A01 CSCL 13I

The asymmetric flow within a volute exerts a radial force on a centrifugal impeller. Experimental measurements of the radial forces on the impeller in the presence of cavitation are presented.
Author

N87-22226*# Texas A&M Univ., College Station.
FORCE AND MOMENT ROTORDYNAMIC COEFFICIENTS FOR PUMP-IMPELLER SHROUD SURFACES
Dara W. Childs *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 503-529 (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

Governing equations of motion are derived for a bulk-flow model of the leakage path between an impeller shroud and a pump housing. The governing equations consist of a path-momentum, a circumferential - momentum, and a continuity equation. The fluid annulus between the impeller shroud and pump housing is assumed to be circumferentially symmetric when the impeller is centered; i.e., the clearance can vary along the pump axis but does not vary in the circumferential direction. A perturbation expansion of the governing equations in the eccentricity ratio yields a set of zeroth and first-order governing equations. The zeroth-order equations define the leaking rate and the circumferential and path velocity distributions and pressure distributions for a centered impeller position. The first-order equations define the perturbations in the velocity and pressure distributions due to either a radial-displacement perturbation or a tilt perturbation of the impeller. Integration of the perturbed pressure and shear-stress distribution acting on the rotor yields the reaction forces and moments acting on the impeller face.
Author

N87-22227*# Kaiserslautern Univ. (West Germany).
INFLUENCE OF TORSIONAL-LATERAL COUPLING ON STABILITY BEHAVIOR OF GEARED ROTOR SYSTEMS
P. Schwibinger and R. Nordmann *In* NASA. Lewis Research Center Rotordynamic Instability Problems in High-Performance Turbomachinery, 1986 Jan. 1987 p 531-553 Sponsored in part by Deutsche Forschungsgeneinschaft, West Germany (For primary document see N87-22199 15-37)
Avail: NTIS HC A23/MF A01 CSCL 13I

In high-performance turbomachinery trouble often arises because of unstable nonsynchronous lateral vibrations. The instabilities are mostly caused by oil-film bearings, clearance excitation, internal damping, annular pressure seals in pumps, or labyrinth seals in turbocompressors. In recent times the coupling between torsional and lateral vibrations has been considered as an additional influence. This coupling is of practical importance in geared rotor systems. The literature describes some field problems in geared drive trains where unstable lateral vibrations occurred together with torsional oscillations. This paper studies the influence of the torsional-lateral coupling on the stability behavior of a simple geared system supported by oil-film bearings. The coupling effect is investigated by parameter studies and a sensitivity analysis for the uncoupled and coupled systems.
Author

N87-22228# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
CONFIGURATION SYNTHESIS AND APPROXIMATE MOTION PROGRAMMING OF ROBOT MANIPULATORS Final Report, Oct. 1983 - Sep. 1986
K. C. Gupta 10 Dec. 1986 14 p
(Contract DAAG29-83-K-0144)
(AD-A176403; ARO-20125.13-EG) Avail: NTIS HC A02/MF A01 CSCL 13I

A systematic approach to the configuration synthesis of robot arms and wrists has been developed. A simple method for representing and analyzing robots, called the zero reference position method has been developed. The analysis includes forward and inverse kinematics, direct and inverse dynamics, and robust numerical algorithms. A method for approximate manipulation based upon goal chasing strategy has been developed which is suitable for gross robot motions.
GRA

N87-22229# Naval Postgraduate School, Monterey, Calif.
NON-SINGULAR MODELING OF RIGID MANIPULATORS M.S. Thesis
Khayyam Mohammed Dec. 1986 81 p
(AD-A176609) Avail: NTIS HC A05/MF A01 CSCL 13I

A problem arises when conventional kinematic equations that minimize computational time are used to model a rigid revolute robot arm. Mathematical singularities result when successive link axes line up such that their angles are 0 or 180 degrees. This may result in erratic of singularity. One solution is to spend a minimum amount of time at the singular position or to avoid this position altogether. Another solution is to use other sets of equations, instead of the regular resolved-rate equations, to model the robot arm. This thesis shows how using equations based on Newton's Second Principle of dynamics for three link, two degree of freedom manipulator, the problem of singularity is avoided. The equations are demonstrated in a simulation program.
GRA

N87-22230# Army Military Personnel Center, Alexandria, Va.
STUDY OF ROBOTIC MANIPULATORS SUBJECTED TO BASE DISTURBANCES Final Report M.S. Thesis
Albert B. Tanner 16 Jan. 1987 226 p
(AD-A176730) Avail: NTIS HC A11/MF A01 CSCL 06D

Manipulators mounted on moving platforms have many practical applications. Unlike industrial manipulators, which operate in highly structured environments, the mobile manipulator is subject to arbitrary base motion disturbances which create control problems and degrade performance. Previous research demonstrated that conventional controllers were unable to compensate for the base motion disturbances. This thesis demonstrates a control strategy to compensate for base motion. A planar, three degree of freedom manipulator is used to perform a typical application. Both an uncoupled and a coupled PD controller are designed which result in satisfactory performance when the manipulator's base is stationary, but which fail to acceptably control the manipulator with the base moving. A compensator is designed which utilizes base motion disturbance measurements. The manipulator with either PD controller, using the sensory base information, can successfully perform the task. The compensator is demonstrated experimentally using a PUMA 250 robot mounted on a mobile platform.
GRA

N87-22231# Oak Ridge National Lab., Tenn.
APPLICATION OF A TRACTION-DRIVE 7-DEGREES-OF-FREEDOM TELEROBOT TO SPACE MANIPULATION
D. P. Kuban and W. R. Hamel 1987 18 p Presented at the 10th American Astronautical Society Annual Guidance and Control Conference, Keystone, Colo., 31 Jan. 1987
(Contract DE-AC05-84OR-21400)
(DE87-004616; CONF-870147-1) Avail: NTIS HC A02/MF A01

The Space Station Program marks a new era in space exploration and habitation. To meet the challenges of this new era, more extensive use of remote manipulation and robotics is expected. This paper describes a new space telerobot concept which addresses both teleoperations and robotics needs of future space programs, while merging the desirable characteristics of both technologies. This new concept is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges desirable characteristics of teleoperation and robotic technologies. Presented here are design goals for the telerobot, a description of the

mechanical and control abilities, and applications for Earth and space. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance. Further development of this telerobot is in progress at the Oak Ridge National Laboratory. DOE

N87-22232# Louisiana State Univ., Baton Rouge. Dept. of Computer Science.
ON TERRAIN ACQUISITION BY A FINITE-SIZED MOBILE ROBOT IN PLANE
N. S. V. Rao, S. S. Iyengar, C. C. Jorgensen, and C. R. Weisbin (Oak Ridge National Lab., Tenn.) 1987 7 p Presented at the IEEE International Conference on Robotics and Automation, Raleigh, N.C., 30 Mar. 1987 Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE87-005718; CONF-870354-3; CESAR-86/60) Avail: NTIS HC A02

The terrain acquisition problem deals with the acquisition of the complete obstacle terrain model by a mobile robot placed in an unexplored terrain. This is a precursory problem to many well-known find-path and related problems which assume the availability of the complete terrain model. In this paper, we present a method for terrain acquisition by a finite sized robot operating in plane populated by an unknown (but, finite) number of polygonal obstacles; each obstacle is arbitrarily located and has unknown (but, finite) number of vertices. The robot progressively explores newer vertices of the obstacles using sensor equipment. We show that the complete terrain model will be built by the robot in a finite time. We also show that at any point of time the partially acquired terrain suffices for the navigation of the robot during the exploration. Hence we conclude that the navigation techniques for known terrains can be applied for the robot navigation during exploration. DOE

N87-22233# Oak Ridge National Lab., Tenn.
TRACTION-DRIVE TELEROBOT FOR SPACE MANIPULATION
J. N. Herndon, W. R. Hamel, and D. P. Kuban 20 Feb. 1987 14 p Presented at the IEEE International Conference on Robotics and Automation, Raleigh, N.C., 30 Mar. 1987
(Contract DE-AC05-84OR-21400)
(DE87-005326; CONF-870354-2) Avail: NTIS HC A02/MF A01

The National Aeronautics and Space Administration (NASA) Space Station Program marks the beginning of a new era in space utilization and habitation. Extensive use of remote manipulation and robotics to reduce astronaut extra-vehicular activity is expected. Emphasis on teleoperator technology in early space station phases, followed by growth of autonomous robotics capabilities, is planned. A new telerobot concept has been developed at Oak Ridge National Laboratory (ORNL), under NASA Langley Research Center sponsorship, to address the technical needs of both teleoperations and robotics for these future NASA programs. The concept is based on traction drives, redundant kinematics, modular construction, and a state-of-the-art distributed, hierarchical control system. DOE

N87-22234# Flow Research, Inc., Kent, Wash. Automation Inspection and Controls Div.
OPTICAL INTERFEROMETRY DIMENSIONAL GAUGE FOR DIMENSIONAL GAUGING OF PRECISION HIGH SPEED AIRCRAFT BEARING COMPONENTS Final Report, Apr. - Nov. 1986
Roger F. Johnson Nov. 1986 24 p
(Contract F33657-85-C-2280)
(AD-A177338; FLOW-TD-390; ASD-TR-87-5008) Avail: NTIS HC A02/MF A01 CSCL 13I

This report describes the design and test of an optical interferometric dimensional gauge used for precision bearing components. The system's requirements and goals are addressed for each of the gauge components - air bearings, magnetic levitation and translation, interferometers, gauge stations, electronics hardware. In addition, tests and evaluations are covered for gauging accuracy and repeatability and temperature effects. Results of gauging forty 11/16-inch balls and forty 3/4-inch balls are included to demonstrate the measuring capability. GRA

N87-22235*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GEAR TOOTH STRESS MEASUREMENTS ON THE UH-60A HELICOPTER TRANSMISSION
Fred B. Oswald Mar. 1987 17 p
(NASA-TP-2698; E-3357; NAS 1.60:2698) Avail: NTIS HC A02/MF A01 CSCL 13I

The U.S. Army UH-60A (Black Hawk) 2200-kW (3000-hp) class twin-engine helicopter transmission was tested at the NASA Lewis Research Center. Results from these experimental (strain-gage) stress tests will enhance the data base for gear stress levels in transmissions of a similar power level. Strain-gage measurements were performed on the transmission's spiral-bevel combining pinions, the planetary Sun gear, and ring gear. Tests were performed at rated speed and at torque levels 25 to 100 percent that of rated. One measurement series was also taken at a 90 percent speed level. The largest stress found was 760 MPa (110 ksi) on the combining pinion fillet. This is 230 percent greater than the AGMA index stress. Corresponding mean and alternating stresses were 300 and 430 MPa (48 and 62 ksi). These values are within the range of successful test experience reported for other transmissions. On the fillet of the ring gear, the largest stress found was 410 MPa (59 ksi). The ring-gear peak stress was found to be 11 percent less than an analytical (computer simulation) value and it is 24 percent greater than the AGMA index stress. A peak compressive stress of 650 MPa (94 ksi) was found at the center of the Sun gear tooth root. Author

N87-22236 Washington State Univ., Pullman.
DYNAMICS AND CONTROL OF FLEXIBLE ROBOTIC MANIPULATORS Ph.D. Thesis
K. Krishnamurthy 1986 210 p
Avail: Univ. Microfilms Order No. DA8702551

Aspects related to the dynamics and control of high speed, light weight robotic manipulators are discussed. A dynamic model including flexibility effects for planar motion of flexible robotic arms is presented. Theoretical and experimental results are presented that show that the interaction between the rigid body motion and the elastic motion can be significant. An optimal control algorithm for rest-to-rest maneuvers without large starting or stopping transients and with minimum residual vibration of flexible robotic arms is developed. The optimal control algorithm requires a small number of on-line arithmetic operations and thus can be implemented by a small microprocessor based computer. Simulated results for two examples are presented. Practical issues related to the implementation of the control algorithm are also discussed. The large amplitude motion of a beam undergoing three dimensional base translation and an uniaxial base rotation is also considered. Optimal rest-to-rest maneuvers of a two-link planar manipulator with rigid links are discussed. Dissert. Abstr.

N87-22237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 2000-HOUR CYCLIC ENDURANCE TEST OF A LABORATORY MODEL MULTIPROPELLANT RESISTOJET
W. Earl Morren and James S. Sovey 1987 24 p Presented at the 19th International Electric Propulsion Conference, Colorado Springs, Colo., 11-13 May 1987; sponsored by AIAA, DGLR and JSASS
(NASA-TM-89854; E-3521; NAS 1.15:89854; AIAA-87-0993) Avail: NTIS HC A02/MF A01 CSCL 13I

The technological readiness of a long-life multipropellant resistojet for space station auxiliary propulsion is demonstrated. A laboratory model resistojet made from grain-stabilized platinum served as a test bed to evaluate the design characteristics, fabrication methods, and operating strategies for an engineering model multipropellant resistojet developed under contract by the Rocketdyne Division of Rockwell International and Technion Incorporated. The laboratory model thruster was subjected to a

2000-hr, 2400-thermal-cycle endurance test using carbon dioxide propellant. Maximum thruster temperatures were approximately 1400 C. The post-test analyses of the laboratory model thruster included an investigation of component microstructures. Significant observations from the laboratory model thruster are discussed as they relate to the design of the engineering model thruster.
Author

N87-22238# Institut Francais du Petrole, Paris (France).
ROD PENETRATION IN LIQUIDS
C.-P. Woidneck 14 May 1986 10 p Presented at the 9th International Symposium on Ballistics, Shrivenham, England, 29 Apr. - 1 May 1986
(Contract DRET-85-027)
(ISL-CO-212/86; ETN-97-99633) Avail: NTIS HC A02/MF A01

Rod projectiles of Cu (aspect ratio 8) were impacted into water, glycerol, and methanol at velocities of 2500 and 5000 m/sec to study the effect of compressibility and to investigate the material behavior in the last phase of the cratering process. After the transient phase of penetration which could not be recognized, the stationary penetration process is found to be exactly hydrodynamic. The measured rod deformation and penetration rates show good agreement with those calculated on the basis of the incompressible Bernoulli equation. When the projectile is completely deformed the process of cratering does not stop. The further penetration which is twice the hydrodynamic penetration depth is characterized by a constant penetrator mass and decreasing penetration velocity. The last penetration phase is interpreted, including an analytical expression for the final penetration depth. ESA

N87-22239*# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
EXPERIMENTAL STUDY OF UNSTEADY HYDRODYNAMIC FORCE MATRICES ON WHIRLING CENTRIFUGAL PUMP IMPELLERS Ph.D. Thesis
Jery Belgacem 1986 196 p
(Contract NAS8-33108)
(NASA-CR-179084; NAS 1.26:179084; Rept-200.22) Avail: NTIS HC A09/MF A01 CSCL 13K

An experimental facility was constructed and instrumented. A set of centrifugal flow pumps whose impellers were made to follow a controlled circular whirl motion were studied. The aim was to characterize the steady and unsteady fluid forces measured on the impeller under various pump operating conditions. The postulation was that the unsteady lateral forces result from interactions between the impeller and the surrounding diffuser and/or volute (via the working fluid), and that under certain flow regimes these forces can drive unstable lateral motions of the pump rotor. The lateral hydrodynamic forces were decomposed into their steady and unsteady parts, the latter being further expressed in terms of a generalized fluid stiffness matrix. Conclusions regarding the effect of impeller geometry could not be reached given the similarity of the tested designs. However, other results on phenomena such as skin friction and leakage flow are presented. Some of the findings are compared to experimental and theoretical data from other sources. Finally, the rotordynamic consequences of the results are discussed as the present data were applied to the case of the Space Shuttle Main Engine (SSME) High Pressure Oxidizer Turbopump (HPOTP).
Author

N87-22240# Oak Ridge National Lab., Tenn.
MANIPULATOR TECHNOLOGY: THE CRITICAL ELEMENT OF USEFUL AUTONOMOUS WORKING MACHINES
W. R. Hamel and S. M. Babcock 1986 13 p Presented at the Intelligent Autonomous Systems International Conference, Amsterdam, Netherlands, 8 Dec. 1986
(Contract DE-AC05-84OR-21400)
(DE87-003657; CONF-861265-1) Avail: NTIS MF A01

The structure and characteristics of mobile autonomous robots which can perform useful work are discussed. The objective of the discussion is to assess the state of the technology particularly with regard to robot mechanization and the implementation of a human-like performance capability. Technology limitations in manipulators and locomotion are significant. If not task constrained, it appears that an anthropomorphic autonomous robot would likely be much larger physically and an order of magnitude heavier than a human equivalent. Research in high-performance, lightweight manipulators, servoactuators, and power supply systems is needed. DOE

N87-22241# TeleRobotics International, Inc., Knoxville, Tenn.
TRACTION DRIVE SEVEN DEGREES-OF-FREEDOM TELEROBOT ARM: A CONCEPT FOR MANIPULATION IN SPACE
H. L. Martin and D. P. Kuban 1987 10 p Presented at the International Topical Meeting on Remote Systems and Robotics in Hostile Environments, Pasco, Wash., 29 Mar. 1987 Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE87-004066; CONF-870301-9) Avail: NTIS HC A02/MF A01

This new concept for manipulation in space is based on knowledge and experience gained from manipulator systems developed to meet the needs of remote nuclear applications. It merges the best characteristics of teleoperation and robotic technologies. The design goals for the telerobot, a mechanical and control description, and technology areas that must be addressed for successful implementation will be presented and discussed. The concept incorporates mechanical traction drives, redundant kinematics, and modular arm subelements to provide a backlash-free manipulator capable of obstacle avoidance. Further development of this arm is in progress at Oak Ridge National Laboratory. DOE

N87-22242*# Oak Ridge National Lab., Tenn.
TELEROBOTIC TECHNOLOGY FOR NUCLEAR AND SPACE APPLICATIONS
J. N. Herndon and W. R. Hamel Mar. 1987 13 p Presented at the AIAA, NASA and U.S. Air Force Symposium, Arlington, Va., 9 Mar. 1987 Sponsored by NASA
(Contract DE-AC05-84OR-21400)
(NASA-CR-180923; NAS 1.26:180923; DE87-007012; CONF-870395-1) Avail: NTIS HC A02/MF A01 CSCL 13I

Telerobotic development efforts at Oak Ridge National Laboratory are extensive and relatively diverse. Current efforts include development of a prototype space telerobot system for the NASA Langley Research Center and development and large-scale demonstration of nuclear fuel cycle teleoperators in the Consolidated Fuel Reprocessing Program. This paper presents an overview of the efforts in these major programs. DOE

N87-22243# National Aerospace Lab., Tokyo (Japan).
AN INVESTIGATION OF EARLY DETECTION OF DEFECTS IN BALL BEARINGS BY VIBRATION MONITORING: DETECTION LIMIT OF FLAKING
Toshio Miyachi and Katsumi Seki 1986 20 p In JAPANESE; ENGLISH summary
(NAL-TR-902; ISSN-0389-4010; Rept-3) Avail: NTIS HC A02/MF A01

With the advancement of vibration measurement techniques, it has become possible to detect very small defects in rolling element bearings. The practical limit of defect detection of radially loaded ball bearings was evaluated by measurement and analysis of the vibrations of test bearings which had been purposely made defective. It was shown that a defect of 0.3 mm diameter could be detected by the accelerometers mounted on the bearing housing. This means that flakings which are generated in heavily loaded bearings can be detected at a very early stage of bearing failure.
Author

N87-22244# National Aerospace Lab., Tokyo (Japan).
LUBRICATION PROPERTIES OF MOLYBDENUM DISULFIDE FILMS DEPOSITED BY RF SPUTTERING METHOD
Makoto Nishimura, Masataka Nosaka, Mineo Suzuki, Katsumi Seki, and Yukio Miyakawa 1986 64 p In JAPANESE; ENGLISH

summary
(NAL-TR-903; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

A radio frequency sputtering apparatus with a pair of targets has been developed for depositing a film of uniform thickness onto a complex-geometric specimen such as the retainer of a ball bearing. The deposition characteristics of the apparatus were compared with those of the conventional sputtering apparatus. Lubrication properties of MoS2 films made by these devices were also compared under a variety of conditions. Finally, friction and wear of MoS2 films applied to angular-contact type ball bearings of 20 mm bore were studied in air, nitrogen and vacuo. The two-target sputtering has an advantage mentioned above. However, the films deposited by the method exhibited a rather short wear life because of the temperature rise of the substrate during ion bombardment and during the sputtering process. This temperature dependence was observed in films on those substrates that had been heated with a built-in heater during sputtering. The film thickness measurement and the observation by an electron microscope showed this was attributed to the porous growth of films. Thus substrates should be kept at low temperatures when one wants to obtain a MoS2 film of high quality. As a whole, sputtered MoS2 are an excellent lubricant under sliding contact as well as rolling contact conditions in regard to friction force and endurance life. Author

N87-22245*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
DEVELOPMENT OF GAS-TO-GAS LIFT PAD DYNAMIC SEALS, VOLUMES 1 AND 2 Final Report
A. N. Pope and D. W. Pugh May 1987 189 p
(Contract NAS3-20043)
(NASA-CR-179486; NAS 1.26:179486; R87-AEB432) Avail: NTIS HC A09/MF A01 CSCL 11A

Dynamic tests were performed on self acting (hydrodynamic) carbon face rotary shaft seals to assess their potential, relative to presently used labyrinth seals, for improving performance of aircraft gas turbine engines by reducing air leakage flow rate at compressor end seal locations. Three self acting bearing configurations, designed to supply load support at the interface of the stationary carbon seal and rotating seal race, were tested. Two configurations, the shrouded taper and shrouded flat step, were incorporated on the face of the stationary carbon seal element. The third configuration, inward pumping spiral grooves, was incorporated on the hard faced surface of the rotating seal race. Test results demonstrated seal leakage air flow rates from 75 to 95% lower that can be achieved with best state-of-the-art labyrinth designs and led to identification of the need for a more geometrically stable seal design configuration which is presently being manufactured for subsequent test evaluation. Author

N87-22246*# Mechanical Technology, Inc., Latham, N. Y.
EHD ANALYSIS OF AND EXPERIMENTS ON PUMPING LENINGRADER SEALS Final Report
M. W. Eusepi and J. A. Walowit Jun. 1986 93 p
(Contracts DEN3-343; DE-AI01-85CE-50112)
(NASA-CR-179570; DOE/NASA/0343-1; NAS 1.26:179570; MTI-86TR33) Avail: NTIS HC A05/MF A01 CSCL 11A

Analysis and design charts have been generated to provide design data for Pumping Leningrader Reciprocating Rod Seals. The analytical treatment divides the seal into three regions: an inlet zone, induced with the use of an expansion ring, a contact zone, and an exit zone. Complete solutions have been obtained by matching elasticity equations with hydrodynamic theory. Experiments, although of a limited nature, did demonstrate the ability of the seal design analysis to provide viable seals. Author

N87-22247*# Houston Univ., Tex. Dept. of Electrical Engineering.
PRECISE COMPUTER CONTROLLED POSITIONING OF ROBOT END EFFECTORS USING FORCE SENSORS Semiannual Status Report
Leang S. Shieh and Bayliss C. McInnis 15 Jun. 1987 26 p
(Grant NAG9-211)
(NASA-CR-180925; NAS 1.26:180925) Avail: NTIS HC A03/MF A01 CSCL 13I

A major problem in space applications of robotics and docking of spacecraft is the development of technology for automated precise positioning of mating components with smooth motion and soft contact. To achieve the above objective, a design method was developed for optimally placing the closed-loop poles of a discretized robotic control system at exact prescribed locations inside the unit circle of the complex z-plane. The design method combines the merits of the pole placement and the linear quadratic design approaches. The proposed design procedure is based on the assignment of one real eigenvalue or two complex conjugate (or real) eigenvalues at each design step. The method involves solutions of simple algebraic equations and this is considered to be efficient for on-line or off-line computations. Also, two methods for the linearization of the nonlinear model of a robotic manipulator were presented. Since automatic control of multi-degree freedom robotic manipulators involves high nonlinear equations of systems, a pilot project was proposed involving the control of a one-dimensional system. This simple system can be readily implemented for testing the concepts and algorithms. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N87-22248# University of Southern California, Los Angeles. Dept. of Electrical Engineering.
BASIC RESEARCH IN RELIABILITY FOR REAL SYSTEMS Final Technical Report, 15 Jul. 1984 - 14 Jul. 1986
Victor O. Li 20 Aug. 1986 7 p
(Grant AF-AFOSR-6448-84)
(AD-A177324; AFOSR-87-0232TR) Avail: NTIS HC A02/MF A01 CSCL 12A

The goal of our research is to develop practical models and efficient algorithms to analyze and evaluate the reliability/availability/maintainability of complex systems in which component failures are statistically dependent and each component is subject to degradations before complete failure. The Event-Based Reliability Model (EBRM) was developed to model and analyze the reliability of a network in which component failures are statistically dependent. In EBRM, the events that could cause component failures were modeled explicitly. This approach required far fewer parameters than the traditional model employing conditional probabilities. The EBRM was also proved to be a completely general model which could be applied to various types of failure dependencies. For reliability evaluations, many existing algorithms for computing network reliability could be used with minor modifications and no significant increase in computational complexity. An improved algorithm for the approximate evaluation of network performance was also developed. For multi-state systems, ordered enumeration was used to approximate and bound system reliabilities and other performance measures, and an efficient algorithm was developed for this purpose. Author (GRA)

N87-22249# North Carolina Univ., Chapel Hill. Operations Research and Systems Analysis.
ESTIMATING THE s-t RELIABILITY FUNCTION USING IMPORTANCE AND STRATIFIED SAMPLING
George S. Fishman Jun. 1986 37 p
(Grant AF-AFOSR-0140-84)
(AD-A177570; UNC/ORSA/TR-86/5; AFOSR-87-0209TR) Avail: NTIS HC A03/MF A01 CSCL 12B

This paper considers an undirected network G with node set V and arc set E = 1,....,n. Nodes are perfect but arcs fail randomly and independently with known probabilities 1-p sub 1 ,...,1-p sub n. This paper describes a highly efficient Monte Carlo sampling plan for estimating a reliability function where P denotes a set of points in the n'- dimensional unit hypercube. The method combines importance and stratified sampling techniques. GRA

N87-22250# Technical Research Centre of Finland, Espoo. Metals Lab.
DEFECT CHARACTERIZATION BY ULTRASONIC DIFFRACTION TECHNIQUES
Jorma Pitkaenen 1986 44 p Sponsored by the Finnish Ministry of Trade and Industry
(VTT-444; ISBN-951-38-2721-6; ISSN-0358-5077; ETN-87-99840) Copyright Avail: NTIS HC A03/MF A01; Research Center of Finland, Espoo, Finland FIM35

Three steel blocks with notches of different sizes and orientations were tested with satellite-pulse-observation (SPOT) and peak-echo techniques (PE). The shear-wave mode was used. The best results in sizing defects are achieved by using the PE technique with a 45 deg angle probe. The average error is -0.5 mm and the standard deviation + or - 1.3 mm. The corresponding values using the same technique and a 60 deg angle probe are 2.8 mm and + or - 2.1 mm. The average error is -0.5 mm and standard deviation + or - 2.3 mm by transit time difference in SPOT. The evaluation from the frequency content in sizing defects by SPOT gives an average error of -0.3 mm and a standard deviation of + or - 2.3 mm. ESA

N87-22251# Construcciones Aeronauticas S.A., Madrid (Spain). Dept. of System Engineering.
ROBOTS APPLIED TO NONDESTRUCTIVE INSPECTION (PROJECT SIRO)
J. I. Molina 1984 4 p
(ETN-87-99845) Avail: NTIS HC A02/MF A01

The SIRO, robotized nondestructive inspection system for aircraft manufacturing is described. Operational performance and flexibility, integration within a CAD/CAM environment, and ultrasonic options are discussed. ESA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N87-22252# Maryland Univ., College Park. Dept. of Aerospace Engineering.
DYNAMIC FINITE ELEMENT MODELING OF FLEXIBLE STRUCTURES Final Report, 1 Sep. 1985 - 23 Feb. 1986
C. S. Choi, E. R. Christensen, and S. W. Lee 20 Nov. 1986 39 p
(Grant AF-AFOSR-0352-85)
(AD-A177168; AFOSR-87-0165TR) Avail: NTIS HC A03/MF A01 CSCL 13M

In Part 1, reduced basis techniques are applied to the problem of the nonlinear analysis of the dynamics of unrestrained flexible structures. The reduced bases used consisted of mode shapes of the structure as well as some modal derivatives. The technique was tested on a simple spacecraft structure. The numerical results indicated that the technique did not appear very promising for this type of problem. In Part 2, a finite element technique is used for analysis of very flexible structures undergoing deployment maneuvers. The structure is assumed to consist of flexible bars attached to a rigid mass. The description of elastic deformation is based on the total Lagrangian formulation which allows finite rotation. Numerical tests demonstrates the validity of the present approach. GRA

N87-22253# International Business Machines Corp., San Jose, Calif. General Products Div.
PLASTIC PROPERTIES OF THIN FILMS ON SUBSTRATES AS MEASURED BY SUB-MICRON INDENTATION HARDNESS AND SUBSTRATE CURVATURE TECHNIQUES
M. F. Doerner, D. S. Gardner, and W. D. Nix 1986 26 p Prepared in cooperation with Stanford Univ., Calif.
(Contract MDA903-80-C-0432; Grant AF-AFOSR-0051-86)
(AD-A177174) Avail: NTIS HC A03/MF A01 CSCL 11C

Substrate curvature and sub-micron indentation measurements have been used recently to study plastic deformation in thin films on substrates. Both of these techniques have been employed to study the strength of aluminum and tungsten thin films of silicon substrates. In the case of aluminum films of silicon substrates, the film strength is found to increase with decreasing thickness. Grain size variations with film thickness do not account for the variations in strength. Wafer curvature measurements give strengths higher than those predicted from hardness measurements suggesting the substrate thickness may be due to image forces on dislocations in the film due to the elastically stiffer silicon substrate. For sputtered tungsten films, where the substrate plays a role in strengthening the film. The observed strengthening effect with decreased thickness may be due to image forces on dislocations in the film due to elastically stiffer silicon substrates. For sputtered tungsten films, where substrate is less stiff than the film, the film strength decreases with decreasing film thickness. GRA

N87-22254# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Bruchmechanik und Mechanische Beanspruchung.
MECHANICAL PROPERTIES OF Al-Li DTD XXXA PLATE MATERIAL
Manfred Peters, Volker Bachmann, Karl Welpmann, Helmut Bellingradt, Johannes Eschweiler, and Reinhold Braun Sep. 1986 78 p
(DFVLR-FB-86-40; ISSN-0171-1342; ETN-87-99684) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany DM 28.50

Monotonic and cyclic mechanical properties of a 25 mm thick plate of the Al-Li alloy DTD XXXA-T651 were compared to different tempers of the conventional Al alloy 2024. The results were correlated to the microstructure, the crystallographic texture, and the fracture behavior. Except for ductility and fracture toughness in short transverse direction, tensile properties, and toughness reach or exceed the values of 2024. A strength profile in through-thickness direction is caused by a pronounced crystallographic texture profile. High cycle fatigue properties as well as fatigue crack propagation behavior are equal or better for the Al-Li alloy in air and NaCl solution. ESA

N87-22255# Brigham Young Univ., Provo, Utah. Dept. of Mechanical Engineering.
INFLUENCE OF GRAIN BOUNDARY STRUCTURE DISTRIBUTION AND PROCESSING HISTORY ON INTERGRANULAR CREEP CAVITATION Progress Report, 1 Mar. 1986 - 28 Feb. 1987
B. L. Adams 12 Mar. 1987 4 p
(Contract DE-FG02-85ER-45203)
(DE87-006922; DOE/ER-45203/2) Avail: NTIS HC A02/MF A01

During the past year two new data sets were analyzed to construct the Intercrystalline Structure Distribution Function (ISDF) for seamless alloy 304 stainless steel tubing. The ISDF shows the unexpected property of isotropy in the physical orientation of special boundaries in this material. Further, although twin related CSL (coincident site lattice) boundaries are prevalent in the structure, other special CSL boundaries are noticeably absent. Some prevalent non-CSL special boundaries have been observed which occur with frequencies greater than random; this suggests that the geometric criterion of specialness in the CSL theory is not sufficient for this material. As a consequence of the forementioned developments we have re-directed our research program to include further measurements of structure in alloy 304 stainless steel sheet in the ascrept condition. This new material condition will allow us to answer the important question of how general the condition of physical orientation isotropy is in this material. Continuing creep testing of this alloy will focus on uniaxial-axial test specimens aligned at variable angles relative to the sheet rolling direction. This testing will be completely unambiguous relative to the state of hydrostatic stress, and will

facilitate a definitive clarification of any cavitation anisotropy which may occur in the structure. Further theoretical studies will include a quantitative identification of non-CSL special boundaries by Gaussian deconvolution of the measured ISDF, and an extension of the theory to include the structure of grain boundary triple junctions. DOE

N87-22256# WEA, Cambridge, Mass.
WAVE PROPAGATION IN TRANSVERSELY ISOTROPIC CONTINUUM MODELS OF LSS (LARGE SPACE STRUCTURES) Interim Report, 1 Sep. 1985 - 1 Jan. 1987
James H. Williams, Jr., Raymond J. Nagem, and Karim G. Salame 1 Jan. 1987 35 p
(Contract F49620-85-C-0148)
(AD-A177271; AFOSR-87-0279TR) Avail: NTIS HC A03/MF A01 CSCL 20K

Continuum models of large repetitive lattice structures are often used to provide computationally efficient analyses of static, dynamic and thermomechanical properties. In this report, a continuum model is used to study wave propagation in lattice structures. Attention is focused on a tetrahedral lattice structure which may be modeled as an equivalent homogeneous transversely isotropic continuum. Numerical results for phase velocities, deviation angles, and wave front surfaces in the equivalent continuum show that wave propagation in lattice structures may be remarkably different from the more familiar wave propagation in isotropic continua. The results given here, which ignore all effects of boundaries of the lattice and which are valid for wavelengths that are long compared with the basic cell size of the lattice, are intended to give insight into how waves may propagate in large repetitive lattice structures. GRA

N87-22257# Northwestern Univ., Evanston, Ill.
IMPACT RESPONSE OF STRUCTURES: GLOBAL LOCAL APPROACH Final Report, 30 Sep. 1982 - 30 Sep. 1986
Leon M. Keer 30 Nov. 1986 7 p
(Grant AF-AFOSR-0330-82)
(AD-A177279; AFOSR-87-0166TR) Avail: NTIS HC A02/MF A01 CSCL 20K

Static and dynamic solutions to indentation problems of large area contact with respect to the structural thickness were solved. Two classes of problems were solved during this time period. They involved the smooth indentation of transversely isotropic beams and the low velocity impact of transversely isotropic beams and plates. In addition to these problems, an investigation into the problem of three-dimensional scattering by a planar crack was begun. GRA

N87-22258# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
AN EXPERIMENTAL AND ANALYTICAL PROGRAM TO DEVELOP CRACK TIP FRACTURE CRITERIA Annual Report, Dec. 1985 - Nov. 1986
C. Schultheisz and W. G. Knauss Dec. 1986 18 p
(Grant AF-AFOSR-0254-84)
(AD-A177286; AFOSR-87-0259TR) Avail: NTIS HC A02/MF A01 CSCL 20K

A summary of progress on the development of instrumentation to determine with great accuracy the in-plane and out-of-plane surface deformations in the vicinity of a crack tip. The purpose is to establish a data base for: (1) guiding theoretical research in characterizing the deformation fields in the crack tip vicinity for fracture research, and (2) to provide factual information for the evaluation of currently proposed theories dealing with crack tip deformation. The experimental tools under development are (D Post's) moire interferometry for the in-plane ones deformations and optical interferometry for the out-of-plane ones. An essential part of this work is the implementation of a computer-based data processing unit, which is able to record and process in nearly real time fringe patterns into strain fields, and, for known - or estimated - constitutive behavior into stress fields. This report summarizes the state of developments with particular attention being given to the elimination of problems in the vacuum deposition procedure for the metal film used in the moire interferometry. Also, insufficiencies with the optical recording system - insufficient collimation by available lenses - has been rectified. The development of a very efficient code for fringe image recognition by Fourier analysis is discussed. GRA

N87-22259# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
SURFACE FLAW CRACK GROWTH IN PLATES OF FINITE THICKNESS Interim Report, Sep. 1980 - Dec. 1985
D. W. Carter, W. R. Canda, and J. A. Blind 15 Jan. 1987 79 p
(AD-A177294; AFWAL-TR-86-4034) Avail: NTIS HC A05/MF A01 CSCL 20K

This combined experimental and analytical study was directed at predicting the growth and shape change of surface flaws under axial loading using crack growth data obtained from simple compact tension specimens. The experimental effort aimed at automating surface crack growth testing using 2219-T851 aluminum specimens. Test variables included different stress ratios, flaw sizes and shapes. Tests were conducted using constant amplitude loading with marker bands to measure shape changes. Compliance techniques were employed in an attempt to automate crack growth data acquisition. Although useful for running tests, these techniques lacked adequate sensitivity when compared to visual measurements. The analytical effort was directed at determining which crack growth models and stress intensity solutions could best predict the growth and shape change of surface flaws. The characterization of surface flaws as semi-ellipses and the independence of crack growth rate and direction were addressed. The resulting model was successful in predicting growth and shape changes under most conditions, but did not adequately predict the effects of load interaction under high stress ratio conditions. GRA

N87-22260# Naval Research Lab., Washington, D. C.
STABILIZATION OF THE COUPLED RETARDED POTENTIAL-FINITE ELEMENT PROCEDURE FOR SUBMERGED STRUCTURAL ANALYSIS Final Report, Oct. 1983 - Sep. 1984
Martin A. Tamm 31 Dec. 1986 24 p
(AD-A177412; NRL-MR-5902) Avail: NTIS HC A02/MF A01 CSCL 20K

A coupled retarded potential-finite element numerical method has been stabilized by removing the time-step stagger in the computations of the coupled parts. This is equivalent to eliminating the dead-time feedback element in a control loop, which is known in control theory to lead in instability. The unstabilized and stabilized coupled procedures are depicted. The test problem studied is a step pressure wave impacting a spherical shell. Displacement and velocity histories are plotted for surface points on the sphere, comparing the stabilized numerical solution, the unstabilized numerical solution, and an established closed-form solution. GRA

N87-22261# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
EXPERIMENTAL VERIFICATION OF A MICROBUCKLING MODEL FOR THE AXIAL COMPRESSIVE FAILURE OF HIGH PERFORMANCE POLYMER FIBERS Interim Report
Steven J. DeTeresa, Roger S. Porter, and Richard J. Farris 5 Jan. 1987 40 p
(Contract N00014-83-K-0228)
(AD-A177468; TR-29) Avail: NTIS HC A03/MF A01 CSCL 11E

For failure initiated by elastic microbuckling of polymer chains or fibrils, the maximum fiber strength is predicted to be equal to the minimum longitudinal shear modulus of the fiber. An excellent linear correlation between measured strengths and torsion moduli was obtained for four liquid crystalline polymer fibers and high modulus graphite fibers. A correlation shows that measured strengths are 30% of the corresponding torsion moduli, the theoretical strengths, for all these fibers. GRA

N87-22262# Ballistic Research Labs., Aberdeen Proving Ground, Md.
OPTICAL PROBING OF ACOUSTIC EMISSION DURING DEFORMATION OF MICROTENSILE SPECIMENS
William J. Bruchey, Jr. Dec. 1986 88 p
(AD-A177576; BRL-TR-2774) Avail: NTIS HC A05/MF A01 CSCL 20K

Optical interferometric techniques were adapted to detect and analyze acoustic emission signals from 304L stainless steel. The objective of this study was to determine the correlation between fracture surface topography and acoustic emission signals emitted by the material during plastic deformation and failure, and to reconcile this information with existing theories of acoustic emission generation in polycrystalline materials. A pneumatic load system was developed to accept an optical interferometer as the device for detecting acoustic emission signals. Microtensile specimens were fabricated which limited the zone of deformation to approximately three cubic millimeters in volume. Use of the optical probe permitted the monitoring of transient surface displacements at locations within fractures of a millimeter of the deforming volume. Results demonstrate that acoustic emission is a volume phenomena. For the small plastic zone size investigated, the acoustic emission counts have been minimized to the extent that signals are separated in time and waveform analysis can be conducted on each of the signals. Test results show that models describing dislocations as the sources of acoustic emission are not sufficient to describe the observed behavior. GRA

N87-22263# Texas Technological Univ., Lubbock. Dept. of Mechanical Engineering.
ANALYTICAL AND EXPERIMENTAL RANDOM VIBRATION OF NONLINEAR AEROELASTIC STRUCTURES Annual Report, 1 Nov. 1985 - 31 Dec. 1986
Raouf A. Ibrahim 28 Jan. 1987 23 p
(Grant AF-AFOSR-0008-85)
(AD-A177805; AFOSR-87-0254TR; AR-2) Avail: NTIS HC A02/MF A01 CSCL 20D

The analytical part deals with the nonlinear response of a three degree of freedom aeroelastic structural model in the neighborhood of combination internal resonance condition. The Fokker Planck equation approach is used to derive a general differential equation for the response statistical joint moments. The equations are solved by using numerical integration. The solution shows that the response coordinates are non-stationary random processes and the three normal modes are in complete nonlinear interaction. The interaction is found to be very strong at a region of internal detuning which is shifted from the exact internal resonance condition. This result is under further investigation by using a non-gaussian closure scheme. The experimental investigation is conducted out on a two degree of freedom model. When the first normal mode is externally excited by a band-limited random excitation, the system mean square response is found to be linearly proportional to the excitation spectral density level up to a certain level above which the two normal modes exhibit discontinuity governed mainly by the internal detuning parameter and the system damping ratios. The results are completely different when the second normal mode is excited. GRA

N87-22264 Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
VISCOPLASTIC ANALYSIS OF FATIGUE CRACKS AT NOTCHES BY THE FINITE ELEMENT METHOD Ph.D. Thesis
Joseph G. Mercer 1986 305 p
Avail: Univ. Microfilms Order No. DA8703165

A finite element program was adapted to analyze a crack growing from a rounded notch under cyclic loading conditions at 1200 F. Plasticity induced closure was modeled by the use of 1-D springs attached to nodes along the crack surface. Analysis of the crack provided information on crack tip stresses, strains, closure effects, and crack opening displacements. These results were used to evaluate experimental crack growth rates under conditions which included notch induced plasticity. Testing of notched specimens showed that high crack growth rates resulted when a short crack was subjected to plastic loading conditions, while short cracks at load levels where there was no notch plasticity exhibited growth rates comparable to long crack data for the same specimen. None of the parameters examined was able to correlate the high crack growth rates for a short crack in a notch plastic zone. An El Haddad correction to the elastic stress intensity solution accounts for the initially high growth rate for short cracks. However, because of its inability to match the details of the observed growth rate variations, this method gave conservative life estimates.
Dissert. Abstr.

N87-22265 California Univ., Los Angeles.
INTEGRATED STRUCTURAL AND CONTROL SYSTEM DESIGN OPTIMIZATION FOR STRUCTURES UNDER DYNAMIC LOADING Ph. D. Thesis
Mehdi Navid 1986 253 p
Avail: Univ. Microfilms Order No. DA8702640

Simultaneous control and structural optimizations are discussed. A set of unified design optimization strategies is developed in which the structural design and/or the controller design can be iterated to improve the performance of the closed loop system. Along with periodic or random loading, a constructive method of simultaneous structural and control optimization is developed which includes constraints on natural frequencies, stresses and certain side constraints. A model or analytical idealization is employed which is accurate enough and is also suitable for integration into the iterative design-analysis loop of the optimization procedure. Likewise, the analysis of the model, that is, the numerical determination of the pertinent stresses and frequencies of the model, are performed in a way which is both consistent with, and takes advantage of the iterative design cycle. The infinite dimensional control theory and the associated approximation theory to define and solve an integrated control/structure optimization problem for a distributed model of a flexible structure are discussed. Dissert. Abstr.

N87-22266 Illinois Univ., Urbana-Champaign.
POSTBUKLING ANALYSIS OF DELAMINATED COMPOSITE PLATES UNDER COMPRESSION Ph.D. Thesis
Fuh-Gwo Yuan 1986 202 p
Avail: Univ. Microfilms Order No. DA8701664

Failure mechanics of delamination problems in composite laminates under compression is investigated. The failure modes in general may include prebuckling, postbuckling, delamination growth and final failure. Buckling load is determined by solving an eigenvalue problem using a subspace iteration technique. A rotational, singular hybrid finite element approach is taken for studying crack-tip stresses during postbuckling. Formulation of the element stiffness matrix is based on the assumption of small strain, large rotation and the recently developed laminate elasticity solution. The variational principle of a modified hybrid functional is employed for derivation of equilibrium equations in each incremental step. Comparisons of the results obtained from the present method and conventional finite elements are made to demonstrate the accuracy and efficiency of the present approach. Mixed-mode stress intensity factors in delaminated composite systems are calculated during postbuckling. Based on a critical Mode-1 fracture criterion, delamination stability is also investigated.
Dissert. Abstr.

N87-22267*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Business Group.
ELEVATED TEMPERATURE CRACK GROWTH Annual Report
S. N. Malik, R. H. VanStone, K. S. Kim, and J. H. Laflen Jan. 1987 43 p
(Contract NAS3-23940)
(NASA-CR-179601; NAS 1.26:179601) Avail: NTIS HC A03/MF A01 CSCL 20K

The objective of the Elevated Temperature Crack Growth Program is to evaluate proposed nonlinear fracture mechanics methods for application to hot section components of aircraft gas turbine engines. Progress during the past year included linear-elastic fracture mechanics data reduction on nonlinear crack

growth rate data on Alloy 718. The bulk of the analytical work centered on thermal gradient problems and proposed fracture mechanics parameters. Good correlation of thermal gradient experimental displacement data and finite element prediction was obtained. Author

N87-22268*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BUCKLING TESTS OF A 10 FOOT DIAMETER STIFFENED CYLINDER WITH RECTANGULAR CUTOUTS
Randall C. Davis and Fred Carder (Tennessee Univ., Knoxville.) Feb. 1987 38 p
(NASA-TM-88996; NAS 1.15:88996) Avail: NTIS HC A03/MF A01 CSCL 20K

A 10-foot diameter aluminum cylinder with rectangular cutouts in its ring and stringer stiffened wall was loaded to failure by an end bending moment. A 24x27 inch cutout, centered on the compression side of the shell, was first cut into the cylinder. After testing, the cutout area was enlarged to a 36/36 inch square cutout that removed the material damaged by buckling during the first test. After the second buckling test, the cutout area was patched with an equivalent stiffness plate bolted over the cutout hole. The cylinder was rotated 120 deg. and a 18x18 inch square hole cut into the center of the new compression side of the shell. Test specimen details, test procedures, and test results are presented. Author

N87-22269# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
STRESS AND DEFORMATION ANALYSIS OF LIGHTWEIGHT COMPOSITE STRUCTURES
Karl Pfeifer and Joerg Bode Oct. 1986 17 p Presented at the 37th International Astronautical Congress, Innsbruck, Austria, 4-11 Oct. 1986 Previously announced in IAA as A87-15939
(MBB-UD-489/86; IAF-86-212; ETN-87-99930) Avail: NTIS HC A02/MF A01

The influence of thermal stress and deformation on curved beams and shells, particularly for the reflector shells of spacecraft antennas, is reviewed. It is shown that the antenna contour distortions can be minimized by thermal expansion coefficients close to zero for all parts, or be a combination of vertical and horizontal displacements which deform the whole shell within the original contour. ESA

N87-22270*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATIC AEROELASTIC EFFECTS ON THE FLUTTER OF A SUPERCRITICAL WING
E. Carson Yates, Jr. and Li-Chuan Chu (PRC Kentron, Inc., Hampton, Va.) Mar. 1987 16 p Presented at the Specialists Meeting on Static Aeroelastic Effects on High Performance Aircraft at the 63rd Meeting of the AGARD Structures and Materials Panel, Athens, Greece, 28 Sep. - 3 Oct. 1986
(NASA-TM-89132; NAS 1.15:89132) Avail: NTIS HC A02/MF A01 CSCL 20K

It is well known that wings with supercritical airfoils generally have lower transonic flutter speeds than similar wings with conventional airfoils and that small increases in angle of attack from zero and the accompanying static aeroelastic deformations have further detrimental effects on transonic flutter. The results of an effort to calculate the effects of angle of attack and the associated aeroelastic deformation on the flutter of a highly swept supercritical wing (TF 8A) by use of the modified strip analysis employed in previous studies of this wing are presented. The spanwise distributions of steady-state section lift-curve slope and aerodynamic center required as input for these calculations were obtained from static aeroelastic calculations for the wing by use of the FL022 transonic code and an assumed dynamic pressure as that used to calculate the statically deformed shape and loading about which the flutter oscillation occurs. The results show that the unconventional backward turn of the transonic dip in the experimental flutter boundary for angles of attack greater than zero is caused by variations in mass ratio and not by static aeroelastic deformation, although inclusion of the latter appears to be required for quantitative accuracy in the calculations. Author

N87-22271*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EVALUATION OF HIGHER-ORDER MODEL METHODS FOR CALCULATING TRANSIENT STRUCTURAL RESPONSE
Charles J. Camarda, Raphael T. Haftka, and Michael F. Riley (PRC Kentron, Inc., Hampton, Va.) Apr. 1987 38 p
(NASA-TM-89134; NAS 1.15:89134) Avail: NTIS HC A03/MF A01 CSCL 20K

A higher-order modal method proposed by Leung for transient structural analysis entitled the force-derivative method is evaluated. This method repeatedly integrates by parts with respect to time the convolution-integral form of the structural response to produce successively better approximations to the contribution of the higher modes which are neglected in the modal summation. Comparisons are made of the force-derivative, the mode-displacement, and the mode-acceleration methods for several numerical example problems for various times, levels of damping, and forcing functions. The example problems include a tip-loaded cantilevered beam and a simply-supported multispan beam. The force-derivative method is shown to converge to an accurate solution in fewer modes than either the mode-displacement or the mode-acceleration methods. In addition, for problems in which there are a large number of closely-spaced frequencies whose mode shapes have a negligible contribution to the response, the force-derivative method is very effective in representing the effect of the important, but otherwise neglected, higher modes. Author

N87-22272# Pennsylvania State Univ., University Park. Materials Research Lab.
THREE-DIMENSIONAL RESIDUAL STRESS CHARACTERIZATION OF THICK PLATE WELDMENTS WITH ADVANCED MEASUREMENT INSTRUMENTATION AND METHODOLOGIES Final Technical Report, Jan. 1984 - Apr. 1986
C. O. Ruud and D. J. Snoha Sep. 1986 179 p Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE87-007697; ORNL/Sub-84-89603/01) Avail: NTIS HC A09/MF A01

A residual study was performed on a thirteen-inch thick, multi-pass, vee groove butt weldment of 2-1/4 Cr 1 Mo steel alloy plate. The sample studied was about 13 inches thick by 9.5 inches along the weld by 35 inches normal to the weld, and was cut from a weldment several times larger along the weld and about 48 inches wide normal to the weld. Residual stresses were measured on the two rolled plate faces and on the two faces exposed by sectioning through the weld and which were normal to the weld center line. Nearly two thousand stress measurements were performed on each of the sample faces along several traverse lines and in two directions in the plane of the surface of the face. Several residual stress readings were performed at each location and the mean of these measurements plotted. The plots indicate the three-dimensional stress field extant in the sample. Further, the sample was cut in a plane parallel with the rolled plate surface to provide two sections about 2-1/4 inches thick and about 10-3/4 inches thick. The newly exposed face was mapped for residual stresses as well as one of the previously mapped faces. Nearly ten thousand residual stress measurements were performed on the thirteen-inch thick multi-pass HSLA steel weldment producing over seventy-two individual plots of stress traverses to provide the most thorough experimental analysis of a thick weldment to date. The data clearly illustrates the complexity of the three-dimensional residual stress state in thick multi-pass steel weldments and the magnitude of the difficulties to be faced in developing numerical models for residual stresses in these weldments. DOE

N87-22273*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTURAL AND AEROELASTIC ANALYSIS OF THE SR-7L PROPFAN
Murray Hirschbein, Robert Kielb, Robert Aiello, Marsha Nall, and Charles Lawrence Mar. 1985 31 p
(NASA-TM-86877; E-2338; NAS 1.15:86877) Avail: NTIS HC A03/MF A01 CSCL 20K

A structural and aeroelastic analysis of a large scale advanced turboprop rotor blade is presented. This 8-blade rotor is designed to operate at Mach 0.8 at an altitude of 35,000 ft. The blades are highly swept and twisted and of spar/shell construction. Due to the complexity of the blade geometry and its high performance, it is subjected to much higher loads and tends to be much less stable than conventional blades. Four specific analyses were conducted: (1) steady deflection; (2) natural frequencies and mode shapes; (3) steady stresses; and (4) aeroelastic stability. State-of-the-art methods were used to analyze the blades including a large deflection, finite element structural analysis, and an aeroelastic analysis including interblade aerodynamic coupling (cascade effects). The study found the blade to be structurally sound and aeroelastically stable. However, it clearly indicated that advanced turboprop blades are much less robust than conventional blades and must be analyzed and fabricated much more carefully in order to assure that they are structurally sound and aeroelastically stable. Author

N87-22274# National Aerospace Lab., Tokyo (Japan).
OPTIMUM DESIGN OF LAMINATED CYLINDRICAL PRESSURE VESSELS
Hisao Fukunaga 1986 13 p In JAPANESE; ENGLISH summary
(NAL-TR-917; ISSN-0389-4010) Avail: NTIS HC A02/MF A01

The optimum design of filament-wound cylindrical pressure vessels under stiffness and strength constraints is discussed. Stiffness constraints are specified as strain conditions both in the axial and circumferential directions. Tsai-Wu failure criterion is used for determining a first-ply-failure strength. The stiffness and strength characteristics of the laminate are discussed based upon the concept of lamination parameters. For small values of allowable axial and circumferential strains, the strain (or stiffness) condition is critical, while for large values of allowable strains the strength condition is critical. The optimal laminate configurations are determined for the various kinds of strain and strength constraints. Author

N87-22275*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE EIGENVALUE AND EIGENVECTOR DERIVATIVES OF A GENERAL MATRIX
Jer-Nan Juang and Kyong B. Lim (PRC Kentron, Inc., Hampton, Va.) Mar. 1987 19 p
(NASA-TM-89127; NAS 1.15:89127) Avail: NTIS HC A02/MF A01 CSCL 20K

The existence of differentiable eigenvalues and eigenvectors for a general matrix is addressed. The eigenspace which contains differentiable eigenvectors is determined and computed by using the concept of subspace intersection in conjunction with the singular value decomposition algorithm. The differentiable eigenvectors associated with repeated eigenvalues should be simultaneously the eigenvectors of the general matrix and its corresponding sensitivity matrix. Furthermore, the derivatives for differentiable eigenvectors associated with repeated eigenvalues can be computed using higher order derivatives of the matrix, whereas the corresponding eigenvalue derivatives are the eigenvalues of the sensitivity matrix. Author

N87-22276*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN EXPERIMENTAL INVESTIGATION OF THE AEROMECHANICAL STABILITY OF A HINGELESS ROTOR IN HOVER AND FORWARD FLIGHT
William T. Yeager, Jr., M-Nabil H. Hamouda (PRC Kentron, Inc., Hampton, Va.), and Wayne R. Mantay Jun. 1987 20 p
(DA Proj. 1L1-62209-AH-76B)
(NASA-TM-89107; L-16280; NAS 1.15:89107; AVSCOM-TM-87-B-5) Avail: NTIS HC A02/MF A01 CSCL 20K

Analysis and testing were conducted in the Langley Transonic Dynamics Tunnel to investigate the aeromechanical stability of a soft inplane hingeless rotor model. Rotor stability data were obtained in hover and in forward flight up to an advance ratio of 0.35. Model rotor parameters evaluated were blade sweep and droop, pre-cone of the blade feathering axis, and blade pitch-flap coupling. Data obtained during these tests are presented without analysis. Author

N87-22277*# Eloret Corp., Palo Alto, Calif.
SIMULATION STUDIES FOR SURFACES AND MATERIALS STRENGTH Semiannual Report, 1 Nov. 1986 - 30 Apr. 1987
Timur Halicioglu 10 Jun. 1987 13 p
(Contract NCC2-297)
(NASA-CR-180539; NAS 1.26:180539) Avail: NTIS HC A02/MF A01 CSCL 20K

Three different investigations based on computer simulations were carried out. Simulation calculations were performed using model potentials with two- and three-body interactions which were represented by the Mie and the Axilrod-Teller potentials, respectively. In the first part, to analyze stability criteria for simple crystals, a parametrical investigation was performed and stability regions for five different crystalline structures were determined with respect to potential energy parameters. To simulate some of the basic surface processes such as diffusion and nucleation, in the second and third parts, silicon surfaces were considered as a specific example. In these studies diffusion of adatoms on stepped surfaces were simulated and energetics associated with the formation of kink sites were calculated. Author

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N87-22278 Regione del Veneto, Mestre-Venezia (Italy).
COMPARATIVE EVALUATION AND GUIDE FOR THE INTEGRATED UTILIZATION OF LANDSAT (MSS AND TM) AND SPOT (HRV) SATELLITES REMOTELY SENSED DATA [VALUTAZIONE COMPARATA E GUIDA ALLUSO INTEGRATED D EI DATI TELERILEVATI DAI SATELLITI LANDSAT (MSS E TM) E SPOT (HRV)]
Alessandro Annoni and Enrico Zini 1986 149 p In ITALIAN; In ITALIAN Sponsored by the CIPE, and the Fondo di Investimenti
(ETN-87-99356) Copyright Avail: Issuing Activity

A LANDSAT/SPOT user's manual is presented, including the description of both types of satellite, their performance, and the data characteristics. Data processing is illustrated, several procedures are explained, and useful parameters are given. ESA

N87-22279# Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH IN GEODESY AND GEOPHYSICS BASED UPON RADIO INTERFEROMETRIC OBSERVATIONS OF EXTRAGALACTIC RADIO SOURCES Final Report, Dec. 1984 - Dec. 1985
Thomas A. Clark, James L. Davis, Carl R. Gwinn, Thomas A. Herring, and James W. Ryan Oct. 1986 107 p
(Contract F19623-83-K-0031)
(AD-A177527; AFGL-TR-86-0234) Avail: NTIS HC A06/MF A01 CSCL 08B

This report consists of a collection of reprints and preprints. Subjects included: description of Mk-III system for very long baseline interferometry (VLBI); geodetic results from the Mk-I and Mk-III systems for VLBI; effects of modeling atmospheric propagation on estimates of baseline length and station height; an improved model for the dry propagation delay; corrections to IAU 1980 nutation series based on VLBI data and geophysical interpretation of those corrections; and a review of the contributions of VLBI to geodynamic studies. GRA

N87-22280 Missouri Univ., Columbia.
A CROP CONDITION AND CROP YIELD ESTIMATION METHOD BASED ON NOAA/AVHRR SATELLITE DATA Ph.D. Thesis
Albert vanDijk 1986 215 p
Avail: Univ. Microfilms Order No. DA8701412

The objective was to develop a crop condition and yield assessment method based on NOAA/Advanced Very High Resolution Radiometer (AVHRR) satellite data for the Sahel and Horn countries of Africa. The method consists of the following steps. (1) Noise in the NOAA/AVHRR satellite data can cause misinterpretation. A proposed procedure reduces the noise by calculating a vegetation index from satellite data that is a measure of the green biomass. The index is then sampled and averaged in time and space and smoothed by applying an algorithm. (2) NOAA satellite data covering large areas are available every week. A system has been developed to pinpoint areas with abnormal vegetation conditions. (3) The yield estimation method is based on the following idea. In Africa a low percentage of the potential agricultural land is used. During grain-filling of a crop, when the green biomass decreases, the vegetation index of the crop decreases. However, the crop's contribution to the vegetation index of the entire area will be small. As a result, the following rule applies: a high vegetation index during the grain filling stage of a crop indicates a large amount of biomass, favorable growing conditions during that critical period, and a large yield. Regression analysis was performed to establish relationships between crop yields of millet, sorghum, and groundnuts and the vegetation index values during the reproductive phase of these crops.
Dissert. Abstr.

N87-22281*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SURFACE BIDIRECTIONAL REFLECTANCE PROPERTIES OF TWO SOUTHWESTERN ARIZONA DESERTS FOR WAVELENGTHS BETWEEN 0.4 AND 2.2 MICROMETERS
Charles H. Whitlock, G. Carlton Purgold, and Stuart R. LeCroy (PRC Kentron, Inc., Hampton, Va.) May 1987 48 p
(NASA-TP-2643; L-16159; NAS 1.60:2643) Avail: NTIS HC A03/MF A01 CSCL 20F

Surface bidirectional reflectance characteristics are presented for the Sonora Desert and the Mohawk Valley at solar zenith angles of 13, 31, and 57 degs at wavelengths between 0.4 and 1.6 microns. Nadir reflectance values are presented for wavelengths between 0.4 and 2.2 microns for solar zenith angles of 13, 17.5, 27, 31, 45, 57, and 62 degs. Data were taken from a helicopter during May 1985 in support of an Earth Radiation Budget Experiment (ERBE), a Stratospheric Aerosol Gas Experiment (SAGE II), and an Advanced Very High Resolution Radiometer (AVHRR) satellite validation experiment. Author

N87-22282# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORTS ON CARTOGRAPHY AND GEODESY, SERIES 1, NUMBER 96 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN, REIHE 1, HEFT NR. 96]
1985 40 p In GERMAN, ENGLISH and FRENCH
(ISSN-0469-4236; ETN-87-99328) Avail: NTIS HC A03/MF A01

A collocation experiment with laser systems and a time-transfer experiment as well as the timing-system of the ground station are described. A reconstitution of the graphic triangulation procedure of the Dutch cartographer, Jacob van Deventer (1500 to 1575) is given. For individual titles, see N87-22283 through N87-22285.

N87-22283# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE RESULT OF THE CO-LOCATION IN WETTZELL (WEST GERMANY) [DIE ERGEBNISSE DER KOLLOCATION IN WETTZELL] **c36**
Hermann Hauck *In its* Repts. on Cartography and Geodesy, Series 1, No. 96 1985 p 5-13 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22282 15-43)
Avail: NTIS HC A03/MF A01

In a co-location experiment three laser systems simultaneously observed the satellite LAGEOS. After a residual analysis of the observed ranges to the satellite, errors in two systems which provided systematic observation errors were detected. ESA

N87-22284# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
JACOB VAN DEVENTER (CIRCA 1500-1575) AND THE BEGINNING OF GRAPHIC TRIANGULATION [JACOB VAN DEVENTER (CA. 1500-1575) UND DIE FRUEHZEIT DER ZEICHNERISCHEN TRIANGULATION]
Peter H. Meurer *In its* Repts. on Cartography and Geodesy, Series 1, No. 96 1985 p 15-23 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22282 15-43)
Avail: NTIS HC A03/MF A01

In 1533, the mathematician Regnier Gemma Frisius formulated a procedure of a rather precise graphic triangulation with compass and quadrant. Jacob van Deventer, father of Dutch cartography, was the first to put the theoretical considerations into practice. His method of determining differences of longitudes by transporting time pieces is being reconstructed. ESA

N87-22285# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE TIMING SYSTEM OF THE FUNDAMENTALSTATION WETTZELL (WEST GERMANY) [ZUR ZEITHALTUNG AUF DER FUNDAMENTALSTATION WETTZELL] **c70**
Wolfgang Schlueter and Dieter Feil *In its* Repts. on Cartography and Geodesy, Series 1, No. 96 1985 p 25-35 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22282 15-43)
Avail: NTIS HC A03/MF A01

The connection of the local time scale UTC (Wettzell) to the international Atomic Time UTC is explained and the offsets are published. Results of a testing experiment for the GPS time transfer receiver are given. ESA

N87-22286# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORTS ON CARTOGRAPHY AND GEODESY, SERIES 1, NUMBER 97 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN, REIHE 1, HEFT 97]
1986 111 p In GERMAN, ENGLISH and FRENCH
(ISSN-0469-4236; ETN-87-99329) Avail: NTIS HC A06/MF A01

Developments of digital and graphic program systems used for cartography and geodesy are presented. Systems of digital image processing, like the Vicom system and their application in

navigation, orthophotomapping, and thematic cartography are discussed. Possibilities of map-projection, such as the development from digital to analog maps are shown. Research activities and fields of application, including regional planning engineering-geodesy as well as the establishment of an official computerized topographic cartographic information system (TOPKIS) are outlined. For individual titles, see N87-22287 through N87-22295.

N87-22287# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
DEVELOPMENT OF ELECTRONIC NAUTICAL CHARTS [ENTWICKLUNG ELEKTRONISCHER SEEKARTEN]
Albert Berger *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 7-12 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

An electronic chart is presented as the subsystem of an integrated digital navigation system with graphic display on board. An exact position determination, more safety, and economies are permitted by continuous update of the data. The realization of an effective digitizing system is described. ESA

N87-22288# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THEMATIC CARTOGRAPHY IN THE FEDERAL OFFICE FOR THE ENVIRONMENT [THEMATISCHE KARTOGRAPHIE IM UMWELTBERICHTSWESEN]
Dieter Fischer *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 13-29 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

An environment information system to be linked with an interactive graphic system (SICAD) is presented. Fields of application of thematic mapping, like regional planning, position determination, and environmental consequences are introduced and steps of development are discussed. Methodical measures of the SICAD programs have to be extended. ESA

N87-22289# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
TOPOGRAPHIC-CARTOGRAPHIC INFORMATION SYSTEM. CONCEPTION AND PRACTICAL APPLICATION [TOPOGRAPHISCH-KARTOGRAPHISCHES STEM - KONZEPTION UND STAND DER BERATUNGEN IN DER ADV]
Dietmar Gruenreich *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 31-39 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

Establishment and utilization of an official computerized topographic cartographic information system (TOPKIS) are presented. It is required as a link between thematic and topographic information. As a first step towards realization, the digitizing of existing maps, examination of demand, and development of system structures are worked out. The practical application of TOPKIS is discussed. ESA

N87-22290# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE VICOM SYSTEM FOR DIGITAL IMAGE PROCESSING AT THE INSTITUTE OF CARTOGRAPHY OF TECHNICAL UNIVERSITY, HANOVER (WEST GERMANY) [DIE VICOM-ANLAGE ZUR DIGITALEN BILDVERARBEITUNG BEIM INSTITUT FUER KARTOGRAPHIE (IFK) DER UNIVERSITAET HANNOVER]
Ernst Jaeger *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 41-49 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

The VICOM system is used for automatic digitizing of cadastral and topographic maps as an alternative to manual digitizing. Hardware and software components of an image processing system for application of processes which can increase the system efficiency are described. Research activities in digital image processing, using the VICOM system, are discussed. ESA

N87-22291# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
AUTOMATION OF THE CONSTRUCTION OF HIGH-VOLTAGE LINES. AN EXAMPLE FOR THE APPLICATION OF AN AUTOMATIC DATAFLOW IN GEODETIC ENGINEERING [AUTOMATION BEI DER TRASSIERUNG VON HOCHSPANNUNGS-FREILEITUNG - EIN BEISPIEL FUER DIE ANWENDUNG DES AUTOMATISCHEN DATENFLUSSES IN DER INGENIEUR-VERMESSUNG]
Wolfgang Lutz and Ortwin Borgmann *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 51-55 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

A program system with which data related to the site on topography and plants are recorded and evaluated in ground plan and elevation (length profile) is described. A first rough overhead line design for the determination of tower sites and the cable curves takes place by means of chain line models. The first design is calculated and optimized by the system. ESA

N87-22292# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
POSITION OF THE ALK (AUTOMATED CADASTRAL MAP) DEVELOPMENT (SEPTEMBER 1985) [STAND DER ALK-ENTWICKLUNG (SEPTEMBER 1985)]
Gerhard Mittelstrass *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 57-64 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

The project ALK (automated cadastral map) consisting of data base and processing (job management and graphic-interactive workstation) is reviewed. Within the framework of the project the conceived program system was developed so that its first configuration can be released. ESA

N87-22293# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
FROM DIGITAL TO ANALOG MAPS. POSSIBILITIES OF MAPPROJECTION [VON DER DIGITALEN ZUR ANALOGEN KARTE - MOEGLICHKEITEN DER KARTENGESTALTUNG]
Gerhard Mittelstrass *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 65-71 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

Optically differing analog maps were derived from a digital map. Instead of the graphic attributes of the geometric elements, the relevant specific significations are entered in the memory. When a map is output, the graphic attributes are then derived from the specific significations by means of a plotting code that can be defined at will. ESA

N87-22294# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
PROJECT: DIGITAL ORTHOPHOTO MAP [PROJEKT: DIGITALE ORTHOPHOTOKARTE]
Gerhard Schweinfurth *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 73-84 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

A method to produce digital orthophoto maps is presented. The program system is based on techniques of digital image processing. The method and problems of character-generating are

described. Effects on the future reproduction process and the importance of the digital orthophoto with regard to an information system are emphasized. ESA

N87-22295# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
HIERARCHICAL PROCESSING OF GRAY VALUES IN RASTER ALGORITHMS [HIEARCHISCHE GRAUWERTVERARBEITUNG IN KARTOGRAPHISCHEN RASTERALGORITHMEN]
Wigand Weber *In its* Repts. on Cartography and Geodesy, Series 1, No. 97 1986 p 85-108 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22286 15-43)
Avail: NTIS HC A06/MF A01

Processes using hierarchies of gray values in raster mode are discussed. Examples of vectorized algorithms for distance transforms, prismatic maps, the coding of hypsometric layers, and the computing of a digital height model from hypsometric layers are given. ESA

N87-22296*# Michigan Univ., Ann Arbor. School of Natural Resources.
EVALUATION OF THE AIRBORNE IMAGING SPECTROMETER FOR REMOTE SENSING OF FOREST STAND CONDITIONS Final Technical Report
Charles E. Olson, Jr. May 1986 86 p
(Contract JPL-956578)
(NASA-CR-180918; JPL-9950-1281; NAS 1.26:180918) Avail: NTIS HC A05/MF A01 CSCL 14B

Five pairs of plots were established in forest stands with one of each pair trenched and covered to prevent precipitation from reaching the tree roots. High winds and falling limbs destroyed the covers on three of the plots. The two remaining plots were in a red pine plantation and in a natural stand of sugar maple. Trees in both plots developed levels of moisture stress more than nine bars higher than control trees on the dates of overflights with the Airborne Imaging Spectrometer (AIS) and the Collins' Airborne Spectroradiometer (CAS). Hemispherical reflectance from stressed and control trees was measured with a Beckman DK2A spectrophotometer. On the day of the AIS overflight, stressed maple foliage was less reflective than the control from 1000 to 1300 nm, but more reflective at wavelengths longer than 1300 nm. Pine foliage was less reflective than the control from 1000 to 1600 nm, but the difference was small at wavelengths longer than 1350 nm. AIS data collected showed brightness values for both maple and pine to be lower than for the controls from 1000 to 1300 nm. CAS data were used to determine the gain in species identification accuracy obtainable with high spectral resolution data. Author

N87-22297# Woods Hole Oceanographic Institution, Mass.
CHART: A COMPUTER PLOTTING PACKAGE FOR THE DISPLAY OF POSITION-DEPENDENT MARINE DATA
A. Martin Dec. 1986 57 p Sponsored by Sandia National Labs.
(PB87-148607; WHOI-86-43) Avail: NTIS HC A04/MF A01 CSCL 08B

The computer program CHART produces plots of navigation tracks and data points in a choice of 14 projections where navigation coordinates are defined. It was written specifically for the plotting and annotation of geological and geophysical data; however, any data which includes geographical coordinates can be plotted. The package was designed for broad flexibility of application and for ease of use. Chart can be used on any Digitial Equipment Corporation VAX machine running VMS. Some additional features of CHART: coastlines, multiple data sets on one grid; empty grid without data points are given. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N87-22298# Illuminated Data, Inc., Albuquerque, N. Mex.
CONCENTRATING PHOTOVOLTAIC COLLECTORS Final Report, 9 Oct. 1985 - 31 Oct. 1986
J. D. Winker Oct. 1986 56 p Sponsored by New Mexico Research and Development Inst.
(PB87-119327; NMRDI-2-74-4608) Avail: NTIS HC A04/MF A01 CSCL 10A

A concentrating photovoltaic (PV) collector, proof-of-principle model, was constructed to demonstrate the advantages of reducing the overall size and bulk of PV collectors. Test results, cost estimates, construction methods and design principles are presented. The feasibility of using one sun silicon solar cells for concentrating PV collectors was demonstrated. The objectives of the program were met, demonstrating a cost effective PV module with a solar conversion efficiency of 14% at standard test conditions. GRA

N87-22299# Parsons (Ralph M.) Co., Pasadena, Calif.
HYDROGEN PRODUCTION FROM LIQUID HYDROCARBONS DEMONSTRATION PROGRAM Final Report, 26 Aug. 1985 - 1 Sep. 1986
J. B. OHara, T. K. Chow, and J. K. Ling 1 Sep. 1986 116 p
(Contract DAAK70-85-C-0092)
(AD-A176346) Avail: NTIS HC A06/MF A01 CSCL 21D

The Air Force now uses diesel engine generators as sources of heat and electricity at selected remote sites. Simultaneously, it has investigated alternative cogeneration candidates that offer improved reliability, maintain ability, and economics. One system that shows high potential is a phosphoric acid fuel cell (PAFC) power plant consisting of a fuel conditioner to convert logistic fuels such as DEF-2, DF-a and JP-4 to a hydrogen-rich gas, and a power conditioner to convert the direct current power to alternating current. The objective was to define, and demonstrate, a fuel conditioner to meet performance criteria estabilished for the Air Force Remote Site Fuel Cell Power Plant program. Key criteria included high fuel-to-hydrogen conversion efficiency, rapid startup and load following capability, and minimum water consumption during operations. A process configuration which has the potential to produce a minimum of 0.365 pound of hydrogen per pound of feed diesel consumed is described. The hydrogen-containing product is suitable for phosphoric acid fuel 1 cell power plant. A 2 mole per hour (hydrogen) demonstration plant was designed, constructed and started up. GRA

N87-22300*# Westinghouse Research and Development Center, Pittsburgh, Pa.
ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT AND DEVELOPMENT OF SINGLE-CRYSTAL SILICON DENDRITIC RIBBON AND HIGH-EFFICIENCY SOLAR CELL PROGRAM Final Report
C. S. Duncan, R. G. Seidensticker, J. P. McHugh, and R. H. Hopkins 29 Aug. 1986 62 p Sponsored in part by DOE
(Contract JPL-956999)
(NASA-CR-180919; JPL-9950-1255; DOE/JPL-956999-84/5; DRL-220; NAS 1.26:180919) Avail: NTIS HC A04/MF A01 CSCL 10A

Efforts to demonstrate that the dendritic web technology is ready for commercial use by the end of 1986 continues. A commercial readiness goal involves improvements to crystal growth furnace throughput to demonstrate an area growth rate of greater than 15 sq cm/min while simultaneously growing 10 meters or more of ribbon under conditions of continuous melt replenishment. Continuous means that the silicon melt is being replenished at

the same rate that it is being consumed by ribbon growth so that the melt level remains constant. Efforts continue on computer thermal modeling required to define high speed, low stress, continuous growth configurations; the study of convective effects in the molten silicon and growth furnace cover gas; on furnace component modifications; on web quality assessments; and on experimental growth activities. Author

N87-22301*# California Univ., Los Angeles. Dept. of Electrical Engineering.
OPTIMIZATION METHODS AND SILICON SOLAR CELL NUMERICAL MODELS Final Report
K. Girardini and S. E. Jacobsen Oct. 1986 319 p
(Contract JPL-957170)
(NASA-CR-180917; JPL-9950-1254; NAS 1.26:180917) Avail: NTIS HC A14/MF A01 CSCL 10A

An optimization algorithm for use with numerical silicon solar cell models was developed. By coupling an optimization algorithm with a solar cell model, it is possible to simultaneously vary design variables such as impurity concentrations, front junction depth, back junction depth, and cell thickness to maximize the predicted cell efficiency. An optimization algorithm was developed and interfaced with the Solar Cell Analysis Program in 1 Dimension (SCAP1D). SCAP1D uses finite difference methods to solve the differential equations which, along with several relations from the physics of semiconductors, describe mathematically the performance of a solar cell. A major obstacle is that the numerical methods used in SCAP1D require a significant amount of computer time, and during an optimization the model is called iteratively until the design variables converge to the values associated with the maximum efficiency. This problem was alleviated by designing an optimization code specifically for use with numerically intensive simulations, to reduce the number of times the efficiency has to be calculated to achieve convergence to the optimal solution. Author

N87-22302*# Westinghouse Electric Corp., Pittsburgh, Pa. Advanced Energy Systems Div.
FLAT-PLATE SOLAR ARRAY PROJECT PROCESS DEVELOPMENT AREA: PROCESS RESEARCH OF NON-CZ SILICON MATERIAL Final Report, Nov. 1983 - Jan. 1986
R. B. Campbell 1986 82 p Sponsored in part by DOE
(Contract JPL-956616)
(NASA-CR-180607; JPL-9950-1230; DOE/JPL-956616-86/1; WAESD-TR-86-0015; NAS 1.26:180607) Avail: NTIS HC A05/MF A01 CSCL 10A

Several different techniques to simultaneously diffuse the front and back junctions in dendritic web silicon were investigated. A successful simultaneous diffusion reduces the cost of the solar cell by reducing the number of processing steps, the amount of capital equipment, and the labor cost. The three techniques studied were: (1) simultaneous diffusion at standard temperatures and times using a tube type diffusion furnace or a belt furnace; (2) diffusion using excimer laser drive-in; and (3) simultaneous diffusion at high temperature and short times using a pulse of high intensity light as the heat source. The use of an excimer laser and high temperature short time diffusion experiment were both more successful than the diffusion at standard temperature and times. The three techniques are described in detail and a cost analysis of the more successful techniques is provided. Author

N87-22303*# Stanford Univ., Calif. Solid State Electronics Lab.
MEASUREMENT OF CARRIER TRANSPORT AND RECOMBINATION PARAMETER IN HEAVILY DOPED SILICON Final Report, 2 Apr. 1985 - 30 Jun. 1986
Richard M. Swanson 1986 41 p Sponsored in part by DOE
(Contract JPL-957159)
(NASA-CR-180608; JPL-9950-1256; DOE/JPL-957159-86/2; NAS 1.26:180608) Avail: NTIS HC A03/MF A01 CSCL 10A

The minority carrier transport and recombination parameters in heavily doped bulk silicon were measured. Both Si:P and Si:B with bulk dopings from 10 to the 17th and 10 to the 20th power/cu cm were studied. It is shown that three parameters characterize transport in bulk heavily doped Si: the minority carrier lifetime tau, the minority carrier mobility mu, and the equilibrium minority carrier density of n sub 0 and p sub 0 (in p-type and n-type Si respectively.) However, dc current-voltage measurements can never measure all three of these parameters, and some ac or time-transient experiment is required to obtain the values of these parameters as a function of dopant density. Using both dc electrical measurements on bipolar transitors with heavily doped base regions and transients optical measurements on heavily doped bulk and epitaxially grown samples, lifetime, mobility, and bandgap narrowing were measured as a function of both p and n type dopant densities. Best fits of minority carrier mobility, bandgap narrowing and lifetime as a function of doping density (in the heavily doped range) were constructed to allow accurate modeling of minority carrier transport in heavily doped Si. Author

N87-22304*# Westinghouse Research and Development Center, Pittsburgh, Pa.
DEVELOPMENT OF HIGH-EFFICIENCY SOLAR CELLS ON SILICON WEB Quarterly Progress Report, 1 Oct. - 31 Dec. 1985
D. L. Meier, J. Greggi, and P. Rai-Choudhury 6 Mar. 1986 69 p Sponsored in part by DOE
(Contract JPL-956786)
(NASA-CR-180222; JPL-9950-1218; DOE/JPL-956786-86/1; NAS 1.26:180222; QPR-7) Avail: NTIS HC A04/MF A01 CSCL 10A

Work is reported aimed at identifying and reducing sources of carrier recombination both in the starting web silicon material and in the processed cells. Cross-sectional transmission electron microscopy measurements of several web cells were made and analyzed. The effect of the heavily twinned region on cell efficiency was modeled, and the modeling results compared to measured values for processed cells. The effects of low energy, high dose hydrogen ion implantation on cell efficiency and diffusion length were examined. Cells were fabricated from web silicon known to have a high diffusion length, with a new double layer antireflection coating being applied to these cells. A new contact system, to be used with oxide passivated cells and which greatly reduces the area of contact between metal and silicon, was designed. The application of DLTS measurements to beveled samples was further investigated. Author

N87-22305*# Westinghouse Research and Development Center, Pittsburgh, Pa.
DEVELOPMENT OF HIGH-EFFICIENCY SOLAR CELLS ON SILICON WEB Quarterly Progress Report, 1 Jan. - 31 Mar. 1986
D. L. Meier, J. Greggi, T. W. OKeeffe, and P. Rai-Choudhury 12 May 1986 57 p Sponsored in part by DOE
(Contract JPL-956786)
(NASA-CR-180610; JPL-9950-1229; DOE/JPL-956786-86/2; NAS 1.26:180610; QPR-8) Avail: NTIS HC A04/MF A01 CSCL 10A

Work was performed to improve web base material with a goal of obtaining solar cell efficiencies in excess of 18% (AM1). Efforts in this program are directed toward identifying carrier loss mechanisms in web silicon, eliminating or reducing these mechanisms, designing a high efficiency cell structure with the aid of numerical models, and fabricating high efficiency web solar cells. Fabrication techniques must preserve or enhance carrier lifetime in the bulk of the cell and minimize recombination of carriers at the external surfaces. Three completed cells were viewed by cross-sectional transmission electron microscopy (TEM) in order to investigate further the relation between structural defects and electrical performance of web cells. Consistent with past TEM examinations, the cell with the highest efficiency (15.0%) had no dislocations but did have 11 twin planes. Author

N87-22306*# Spectrolab, Inc., Sylmar, Calif.
DESIGN, ANALYSIS AND TEST VERIFICATION OF ADVANCED ENCAPSULATED SYSTEMS Final Report, period ending 31 Oct. 1985

Alexander Garcia, III Nov. 1985 240 p Sponsored in part by DOE
(Contract JPL-955567)
(NASA-CR-180612; JPL-9950-1248; DOE/JPL-955567-85/16; DRL-126; NAS 1.26:180612) Avail: NTIS HC A11/MF A01 CSCL 10A

Methods were developed to aid the photovoltaic manufacturer in the design of modules which will optimize the use of materials and methods of manufacture for novel encapsulation schemes. Methods are described for using master curves to enable the design of modules which will withstand pressure loading from wind and/or precipitation as well as stress produced from diurnal and seasonal thermal cycling. Analysis methods using finite element modeling are presented to examine maximum electric field concentrations dependent on the geometry of cells and interconnects. Techniques for determining the operating temperature and optical efficiency of panels are presented. Several novel methods of manufacturing modules are described. Experimental results in the use of conductive polymers in photovoltaic cells as AR coatings, conductivity enhancers and passivation coatings are discussed. Author

N87-22307*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRESS-LIFE INTERRELATIONSHIPS ASSOCIATED WITH ALKALINE FUEL CELLS
Lawrence H. Thaller, Ronald E. Martin, and James K. Stedman (International Fuel Cells Corp., South Windsor, Conn.) 1987 8 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89881; E-3562; NAS 1.15:89881; AIAA-87-9198) Avail: NTIS HC A02/MF A01 CSCL 10B

A review is presented concerning the interrelationships between applied stress and the expected service life of alkaline fuel cells. Only the physical, chemical, and electrochemical phenomena that take place within the fuel cell stack portion of an overall fuel cell system will be discussed. A brief review will be given covering the significant improvements in performance and life over the past two decades as well as summarizing the more recent advances in understanding which can be used to predict the performance and life characteristics of fuel cell systems that have yet to be built. Author

N87-22308*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF STORAGE AND LEO CYCLING ON MANUFACTURING TECHNOLOGY IPV NICKEL-HYDROGEN CELLS
John J. Smithrick 1987 9 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89883; E-3566; NAS 1.15:89883; AIAA-87-9318) Avail: NTIS HC A02/MF A01 CSCL 10C

Yardney Manufacturing Technology (MANTECH) 50 A-hr space weight individual pressure vessel nickel-hydrogen cells were evaluated. This consisted of investigating: the effect of storage and charge/discharge cycling on cell performance. For the storage test the cells were precharged with hydrogen, by the manufacturer, to a pressure of 14.5 psia. After undergoing activation and acceptance tests, the cells were discharged at C/10 rate (5A) to 0.1 V or less. The terminals were then shorted. The cells were shipped to NASA Lewis Research Center where they were stored at room temperature in the shorted condition for 1 year. After storage, the acceptance tests were repeated at NASA Lewis. A comparison of test results indicate no significant degradation in electrical performance due to 1 year storage. For the cycle life test the regime was a 90 minute low earth orbit at deep depths of discharge (80 and 60 percent). At the 80 percent DOD the three cells failed on the average at cycle 741. Failure for this test was defined to occur when the cell voltage degraded to 1 V prior to completion of the 35 min discharge. The DOD was reduced to 60 percent. The cycle life test was continued. Author

N87-22309# Sandia National Labs., Albuquerque, N. Mex.
PHOTOVOLTAIC SYSTEM TECHNOLOGY
G. J. Jones 1987 15 p Presented at the 14th Annual Energy Technology Conference and Exposition, Washington, D.C., 14 Apr. 1987
(Contract DE-AC04-76DP-00789)
(DE87-005069; SAND-87-0058C; CONF-870416-1) Avail: NTIS HC A02/MF A01

The level of photovoltaic system technology maturity is described by discussing four main aspects: simplicity of the photovoltaic system design process; acceptable balance-of-system costs; system reliability in field operating environments, and utility compatibility. DOE

N87-22310*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REGENERATIVE FUEL CELL STUDY FOR SATELLITES IN GEO ORBIT
Leslie VanDine, Olga Gonzalez-Sanabria, and Alexander Levy (International Fuel Cells Corp., South Windsor, Conn.) 1987 8 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89914; E-3607; NAS 1.15:89914; AIAA-87-9200) Avail: NTIS HC A02/MF A01 CSCL 10B

The results of a 12 month study to identify high performance regenerative hydrogen-oxygen fuel cell concepts for geosynchronous satellite application are summarized. Emphasis was placed on concepts with the potential for high energy density and passive means for water and heat management to maximize system reliability. Both polymer membrane and alkaline electrolyte fuel cells were considered, with emphasis on the alkaline cell because of its high performance, advanced state of development, and proven ability to operate in a launch and space environment. Three alkaline system concepts were studied. Results indicate that using near term technology energy densities between 46 and 52 watt-hour/lb can be achieved at efficiencies of 55 percent. Using advanced light weight cell construction which was achieved in experimental cells, composite tankage material for the reactant gases and the reversible stack concept, system energy densities of 115 watt-hours/lb can be projected. Author

N87-22311*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PREDICTION MODEL OF THE DEPTH-OF-DISCHARGE EFFECT ON THE CYCLE LIFE OF A STORAGE CELL
Lawrence H. Thaller and Hong S. Lim (Hughes Research Labs., Malibu, Calif.) 1987 9 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89915; E-3608; NAS 1.15:89915; AIAA-87-9080) Avail: NTIS HC A02/MF A01 CSCL 10C

Cycle life requirements are very high for batteries used in aerospace applications in low Earth orbit. The data base required to establish confidence in a particular cell design is thus both extensive and expensive. Reliable accelerated cycle life testing and performance decay modeling represent attractive alternatives to real-time tests of cycle life. In light of certain long-term cycle life test results, this paper examines a very simple performance decay model developed earlier. Application of that model to available data demonstrates a rigid relationship between a battery's expected cycle life and the depth of discharge of cycling. Further, modeling analysis of the data suggests that a significantly improved cycle life can be obtained with advanced components, materials, and designs; and that cycle life can be reliably predicted from the results of accelerated testing. Author

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N87-22312# Oak Ridge Associated Universities, Inc., Tenn.
THE CO(SUB)2 FUTURE: INEVITABILITY OR CHOICE
E. B. Sigmon Sep. 1986 36 p
(Contract DE-AC05-76OR-00033)
(DE87-004881; DOE/OR-00033/T256) Avail: NTIS HC A03/MF A01

The study discusses emissions of carbon dioxide and influences on future emissions levels. The forces that will determine future CO2 emissions are categorized into two broad evolutionary processes, economic growth and technological progress. The central question in predicting the future trajectory of CO2 emissions is the balance between these competing forces. How various pressures push development and progress in CO2-reducing directions is identified. DOE

N87-22313# National Academy of Sciences - National Research Council, Washington, D. C. US Committee for an International Geosphere-Biosphere Program.
GLOBAL CHANGE IN THE GEOSPHERE-BIOSPHERE: PRIORITIES FOR AN IGBP (INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAM) Final Report
1986 103 p
(Contract DE-FG05-84ER-60277)
(DE87-005034; DOE/ER-60277/T1) Avail: NTIS HC A06/MF A01

A program is defined that would attempt to understand the workings of the Earth and the living organisms on it as a coupled system - a challenge in science that holds the promise of elucidating many of the global concerns of the present day. It would require the participation of many nations and draw upon the efforts of many fields of science. It would be made up of an array of planned, cooperative programs of observation, modeling, and process studies with organized opportunities for joint discussion and interpretation. It would lean on spaceborne observations for global perspective, but it is not a space program, for the preponderance of needed science would deal with processes of change, and vast majority of necessary measurements would need be made on the ground and on the oceans, from within the habitat of life. As an international program it would stand as a separate, focused endeavor that interacts with related, disciplinary programs to increase their effectiveness but without attempting to subsume them or to dictate their goals. DOE

N87-22314# Harris, Miller, Miller and Hanson, Inc., Lexington, Mass.
NOISEMAP 5.1 COMPUTER PROGRAM UPDATE. OPERATOR'S MANUAL, ADDENDUM 2 Final Report
Richard D. Horonjeff Dec. 1986 30 p Previously announced as N79-29963
(AF Proj. 7231)
(AD-A177345; HMMH-260300-Add-2; AAMRL-TR-78-109-Add-2) Avail: NTIS HC A03/MF A01 CSCL 09B

This report, an addendum to AMRL-TR-78-109, describes new capabilities for the NOISEMAP program that allows for the SAE AIR 1751 lateral attenuation algorithm to be substituted for the current NOISEMAP lateral attenuation algorithm for generating noise contours resulting from civil aircraft operations. When used in this mode for civil airport studies, the results normally agree within 0.5 dB with contours computed using the FAA Integrated Noise Model for the same civil aircraft operations. This version of NOISEMAP has been approved for Federal Aviation Regulation Part 150 studies when used with this option invoked. In addition, the NOISEMAP version number is now printed at the top of each output page. GRA

N87-22315# Commonwealth Scientific and Industrial Research Organization, Mordialoc (Australia). Div. of Atmospheric Research.
A SIGNAL PROCESSING APPROACH TO ANALYSING BACKGROUND ATMOSPHERIC CONSTITUENT DATA
I. G. Enting 1986 24 p
(DART-Paper-13; ISBN-0-643-04196-6) Avail: NTIS HC A02/MF A01

A number of techniques such as spline-smoothing and complex-demodulation were previously applied to the analysis of background atmospheric constituent data. It is pointed out that an interpretation in terms of digital filtering unifies these approaches. Earlier studies based on complex demodulation are re-examined in terms of the equivalent digital filtering operations. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; inospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N87-22316# Northeast Radio Observatory Corp., Westford, Mass. Haystack Observatory.
STUDIES OF THE AURORAL IONOSPHERE WITH THE MITHRAS Final Report, Oct. 1982 - Oct. 1985
J. C. Foster 26 Jun. 1986 187 p
(Grant AF-AFOSR-0002-83)
(AD-A176336; AFOSR-86-1067TR) Avail: NTIS HC A09/MF A01 CSCL 04A

The extensive MITHRAS radar data set was the object of extensive analyses of the processes and characteristics of the auroral latitude ionosphere and thermosphere: (1) High-Latitude Electrodynamics: Ionospheric response to substorms at widely separated local times was investigated. (2) Ionospheric Plasma Transport: The effects of plasma convection on the formation of the midlatitude trough were studied utilizing the wide spatial field of view of the Millstone radar. (3) Convection Snapshots: Simultaneous data from spaced instruments were combined to produce snapshots of the polar and auroral convection pattern. (4) Comparisons with Models. (5) Data Bases Studies and Empirical Models: The extensive data set which resulted from the MITHRAS experimental program was incorporated into a multi-instrument, common format data base. (6) Azimuth Scan Experiments: Analysis of the complex data during MITHRAS azimuth scanning experiments resulted in the capability of mapping the convection electric field within the extended field of the radar. (7) Thermosphere and Exosphere: The diurnal variation of exospheric temperature over 30 degrees of latitude around Millstone Hill has been investigated using MITHRAS elevation scan data. GRA

N87-22317# Physical Dynamics, Inc., Bellvue, Wash.
THE POLAR BEAR IONOSPHERIC EXPERIMENTS: A PRE-LAUNCH OVERVIEW Technical Report, 1 Mar. - 31 Oct. 1985
Edward J. Fremouw 9 May 1986 68 p
(Contract DNA001-85-C-0017; Proj. I25-AMXI)
(AD-A176337; PD-NW-86-344R; DNA-TR-86-156) Avail: NTIS HC A04/MF A01 CSCL 04A

Polar BEAR (Polar BEacon and Auroral Research) will carry three ionospheric experiments: (1) a beacon functionally identical to that on HiLat, (2) a three-axis vector magnetometer for detecting the satellite's attitude, and (3) an improved imager, the Auroral/Ionospheric Remote Sensor (AIRS). In addition to providing images of the aurora and airglow at four visual and vacuum ultraviolet wavelengths, AIRS will function as an ultraviolet spectrophotometer. Using AIRS in its imaging mode and receiving stations it will be possible to obtain images of essentially the entire auroral oval in broad daylight as well as in darkness. Polar BEAR is scheduled for launch into a nearly circular orbit near 1000 km altitude and an 82 deg inclination, which orbit will afford a broad view for AIRS and many opportunities for coordinated

observations of: (1) scintillation using the beacons on both HiLat and Polar BEAR, (2) major current systems flowing between the ionosphere and magnetosphere using the magnetometers on both satellites, and (3) energetic electron precipitation and ambient plasma convection at 800 km altitude as recorded with HiLat's electron spectrometer and thermal plasma monitor. These observations should contribute to further understanding of plasma instrumental to the development of density irregularities in the highly dynamic high latitude ionosphere. GRA

N87-22318# Purdue Univ., West Lafayette, Ind. Dept. of Physics.
EFFECTS OF LOCAL MASS ANOMALIES IN EOETVOES-LIKE EXPERIMENTS
C. Talmadge, S. H. Aronson, and E. Fischbach (Washington Univ., Seattle.) 26 May 1986 12 p Presented at the 21st Recontre de Moriond, Les Arcs, Savoie, France, 26 May 1986 Prepared in cooperation with European Organization for Nuclear Research, Geneva (Switzerland); Washington Univ., Seattle
(Contract DE-AC02-76CH-00016)
(DE87-004611; BNL-39061; CONF-8605227-1) Avail: NTIS HC A02/MF A01

The effects of local mass anomalies in Eoetvoes-like experiments are considered. It is shown that in the presence of an intermediate-range non-gravitational force, the dominant contributions to both the sign and magnitude of the Eoetvoes anomaly may come from nearby masses and not from the Earth as a whole. This observation has important implications in the design and interpretation of future experiments, and in the formulation of unified theories incorporating new intermediate-range forces. DOE

N87-22319* Bechtel National, Inc., San Francisco, Calif.
TECTONIC EVALUATION OF THE NUBIAN SHIELD OF NORTHEASTERN SUDAN USING THEMATIC MAPPER IMAGERY Final Report
Carol Tosaya, David Harnish, and Richard Day Apr. 1987 255 p Original contains color illustrations Document contains maps as supplements
(Contract NAS5-28757)
(NASA-CR-180575; NAS 1.26:180575) Avail: Issuing Activity CSCL 08B

Owing to the size, inaccessibility, and harsh, arid climate of the Red Sea Hills, remotely sensed satellite imagery is well suited for analysis of the region. An area of approximately 125,000 sq km of the northernmost Red Sea Hills, which contains the greatest amount of published geologic data using LANDSAT Thematic Mapper (TM) imagery was selected. The regional structure and lithotectonic provinces were defined and delineated. The tectonic evolution of the Nubian Shield was evaluated based on the image interpretation and the compiled tectonic maps. B.G.

N87-22320# Department of Energy, New York. Environmental Measurements Lab.
THE HIGH ALTITUDE SAMPLING PROGRAM: RADIOACTIVITY IN THE STRATOSPHERE Final Report
R. Leifer and Z. R. Juzdan Dec. 1986 65 p
(DE87-006310; EML-458) Avail: NTIS HC A04

Radioactivity data are presented from Project Airstream (aircraft) for the year 1983 and for Project Ashcan (balloon) for the years 1982 and 1984. Due to budgetary constraints both Projects Airstream and Ashcan have been terminated. This will be the final report containing radioactivity data collected during projects airstream and ashcan. Included are gross gamma, gamma spectral and radiochemical analyses of filter samples. Quality control samples submitted along with the air filter samples were analyzed and the results are presented. Low activity on many of the filters precludes the estimation of the stratospheric inventories of Pu-239, -240, and Sr-90. Based on data with count errors less than 20%, the mean Northern Hemisphere stratospheric Sr-90, Pu-239, and -240 concentration for November 1983 was 0.2 + or - 0.1 and 0.009 + or - 0.006 Bq/1000 scm, respectively. DOE

N87-22321*# California Inst. of Tech., Pasadena. Seismological Lab.
MANTLE CONVECTION AND THE STATE OF THE EARTH'S INTERIOR
Bradford H. Hager 1987 29 p
(Grant NAG5-315)
(NASA-CR-180592; NAS 1.26:180592) Avail: NTIS HC A03/MF A01 CSCL 08E

During 1983 to 1986 emphasis in the study of mantle convection shifted away from fluid mechanical analysis of simple systems with uniform material properties and simple geometries, toward analysis of the effects of more complicated, presumably more realistic models. The important processes related to mantle convection are considered. The developments in seismology are discussed. B.G.

N87-22322# Gould, Inc., Middletown, R.I. Ocean Systems Div.
THE TURBULENT GRAVITY WAVE-CRITICAL LEVEL EVOLUTION OF ATMOSPHERIC FLOW Final Report
John R. Grant 19 Dec. 1986 20 p
(Contract F49620-85-C-0114)
(AD-A177274; GOULD-OSD-771-HYDRO-cr-86-10; AFOSR-87-0102TR) Avail: NTIS HC A02/MF A01 CSCL 04A

Strong turbulence may be produced when an internal gravity wave encounters a critical level. This turbulence can dissipate the wave motion, so that the momentum transported by the wave is deposited into the mean flow. Thus, gravity wave-critical level encounters are a significant mechanism by which the wind may be modified by gravity waves. Such an encounter has been computed. The rms turbulent velocities are seen to be a substantial fraction (some 25%) of the wave-induced velocity. The absorption of the wave is seen to alter the wind profile, with turbulence distributing the wave momentum flux above and below the critical level. A variety of features of the wave and turbulence motion may be extracted. One which will be useful for comparison with radar observations is the refractive index structure function (C sub n) - squared and contour plots are displaced. Several other quantities depicting the evolution of the encounter also are presented. Plans for a detailed analysis of these and new computations are outlined. Also discussed are comparisons of these calculations with Doppler radar observations and laboratory measurements. GRA

N87-22323# Danish Space Research Inst., Lyngby.
THEORETICAL AND EXPERIMENTAL EVIDENCE OF A THERMAL RESONANCE INSTABILITY IN THE E-REGION OF THE IONOSPHERE
P. Hoeg 1987 161 p
(DRI-1-87; ISSN-0109-6605) Avail: NTIS HC A08/MF A01

In order to describe the physical processes during the modulation experiment in the high latitude ionosphere the theory of a thermal resonance instability was developed. Strong electromagnetic HF wave fields imposed on a magnetized inhomogeneous plasma were considered. The theory for a quasi one-dimensional thermal resonance instability was developed when a constant ambient electric field was taken into account. The stationary temperature and electron density changes were examined when the strong heating wave approached the reflection altitude. Finally, a description of the experimental instrumentation, data, and statistical analysis is presented. B.G.

N87-22324# SRI International Corp., Menlo Park, Calif.
GENERATION OF TENUOUS PLASMA CLOUDS IN THE EARTH'S ATMOSPHERE Annual Report, 15 May 1985 - 14 Nov. 1986
Robert J. Vidmar 6 Feb. 1987 49 p
(Contract F49620-85-K-0013)
(AD-A177374; AFOSR-87-0100TR) Avail: NTIS HC A03/MF A01 CSCL 04A

Mean electron lifetimes and ionization techniques relevant to generating and sustaining a tenuous plasma in the Earth's atmosphere are presented. The mean electron lifetime, as a

function of electron number density and altitude, was quantified by developing an air chemistry code. The code models deionization for initial conditions appropriate to single pulse electron beam or X ray ionization of the atmosphere from sea level to 100,000 ft. The deionization model indicates that three-body attachment of electrons of oxygen is the dominate process for electron densities less than 10 to the 16th power/cu m. For densities above 10 to the 18th power/cu m two body and three body electron ion recombination dominates and reduces the electron lifetime several orders of magnitude. An electron number density of approximately 10 to the 18th power/cu m is the highest number density that can be efficiently sustained without a severe reduction in electron lifetime. The electrical conductivity corresponding to 10 to the 18th power electrons/cu m in the atmosphere is about 5 mho/m, i.e., the conductivity of seawater. It is suggested that a large plasma cloud could function as an electromagnetic absorber. GRA

N87-22325# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemistry.
FORMATION AND DEACTIVATION OF VIBRATIONALLY EXCITED ATMOSPHERIC MOLECULES Final Report, 5 Nov. 1982 - 31 Jan. 1986
J. Steinfeld, I. Winkler, C. M. Phillips, E. Schweitzer, and R. Stachnik 27 May 1986 42 p
(Contract F19628-83-K-0003)
(AD-A177410; AFGL-TR-86-0116) Avail: NTIS HC A03/MF A01 CSCL 04A

Research has been performed on the following: (1) measurement of nascent vibrational population distribution of NO produced in the N(4S) + O2 reaction, using resonant 2-photon ionization spectroscopy for detection of NO, and (2) evaluation of Coherent Anti-Stokes Raman Spectroscopy as a diagnostic for vibrationally excited molecular species, including ozone. GRA

N87-22326# Naval Research Lab., Washington, D. C. Plasma Physics Div.
DYNAMICS OF THREE DIMENSIONAL IONOSPHERIC PLASMA CLOUDS
J. F. Drake (Science Applications, Inc., McLean, Va.) and J. D. Huba 23 Dec. 1986 22 p
(Contract MIPR-86-512; DNA Proj. W99-QMXW)
(AD-A177438; NRL-MR-5887) Avail: NTIS HC A02/MF A01 CSCL 04A

The first self consistent, three dimensional analysis of plasma cloud evolution in the ionosphere is presented. It is demonstrated that there is a preferred perpendicular scale size associated with three dimensional plasma clouds given by r sub about = C(T sub e + T sub i)/eBzV sub n Gamma sub c where r sub c is the cloud radius, Gamma sub alpha is the temperature of the alpha species, Bz is the ambient magnetic field, V sub n is the neutral wind speed, and Gamma sub c (M) < 1/sq. rt. 2 where M = n sub c/n sub b and n sub c(b) is the cloud(background) density. GRA

N87-22327# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SPECTRAL METHODS FOR GLOBAL ATMOSPHERIC FLOW APPLIED TO THE MODIFIED AFIT (AIR FORCE INSTITUTE OF TECHNOLOGY) FALLOUT PREDICTION MODEL M.S. Thesis
Darrell L. Palmer Sep. 1986 129 p
(AD-A177654; AFIT/GNE/PH/86M-14) Avail: NTIS HC A07/MF A01 CSCL 18H

This thesis predicted the airborne spatial distribution of a high explosive generated dust cloud. A comparison of predicted cloud center positions to experimental data collected from an aircraft flying through the dust cloud center at various times and altitudes was also studied. The analysis was accomplished using a model called AFGL which produces global complex spectral coefficients. Spectral coefficients were applied as inputs into a modified fallout prediction model (called REDRAM) to predict dust mass/cu. m. GRA

N87-22328*# National Aeronautics and Space Administration, Washington, D.C.
ROCK FLOWS
S. N. Matveyev Dec. 1986 50 p Transl. into ENGLISH from Problemy Fizicheskoy Geologii (Moscow, USSR), no. 6, 1938 p 91-121 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-88485; NAS 1.15:88485) Avail: NTIS HC A03/MF A01 CSCL 08G

Rock flows are defined as forms of spontaneous mass movements, commonly found in mountainous countries, which have been studied very little. The article considers formations known as rock rivers, rock flows, boulder flows, boulder stria, gravel flows, rock seas, and rubble seas. It describes their genesis as seen from their morphological characteristics and presents a classification of these forms. This classification is based on the difference in the genesis of the rubbly matter and characterizes these forms of mass movement according to their source, drainage, and deposit areas. Author

N87-22329# Wisconsin Univ., Madison.
MECHANISMS OF EQUATORIAL ANOMALIES IN DYNAMICAL COUPLED OCEAN-ATMOSPHERE MODELS Ph.D. Thesis
Anthony Churchill Hirst 1986 240 p
Avail: Univ. Microfilms Order No. DA8628669

Free equatorial modes for several simple coupled ocean-atmosphere models are determined. They are found to include unstable and damped modes of large zonal scale and long period. Analysis of modal structure reveals the mechanism by which perturbations in such models are able to grow with time. The influence of ocean thermodynamics on unstable mode behavior is systematically explored. The Model 1 ocean features a local thermal equilibrium. In Model 2, temperature advection is the sole ocean thermal process. The Model 3 ocean features both advective and local thermal process, while that of Model 4 features only local thermal processes. The ocean and atmosphere are each represented by linear shallow water equations on the equatorial beta plane, and are linked by traditional couplings. Modes are computed firstly for an atmosphere and ocean without zonal boundaries, and secondly for a zonally bounded ocean coupled to an atmosphere periodic about the globe. Dissert. Abstr.

N87-22330*# Pittsburgh Univ., Pa.
LABORATORY STUDIES OF THE KINETICS OF TROPOSPHERIC AND STRATOSPHERIC ATOM AND RADICAL REACTIONS Final Technical Report, 1 Mar. 1985 - 28 Feb. 1987
Michael F. Golde 1987 4 p
(Grant NGR-39-011-161)
(NASA-CR-180590; NAS 1.26:180590) Avail: NTIS HC A02/MF A01 CSCL 04A

Direct measurements of reaction rate constants and branching fractions for elementary reactions necessary in the modeling of the troposphere or stratosphere are provided. Details of reaction mechanisms are elucidated by studying pressure and temperature dependences of reactions, as well as by use of isotopic labels. Measurement techniques are improved for radical species in the laboratory. Progress and results in each area are given. E.R.

N87-22331*# Maryland Univ., College Park. University Research Foundation.
RESEARCH RELATIVE TO ATMOSPHERE PHYSICS AND SPACECRAFT APPLICATIONS STUDIES Semiannual Status Report, 15 Nov. 1986 - 14 May 1987
Stuart W. Greenwood 29 May 1987 7 p
(Contract NCC5-35)
(NASA-CR-180599; NAS 1.26:180599) Avail: NTIS HC A02/MF A01 CSCL 04A

Progress is reported in several areas of research. Brief descriptions are given in each of the following areas: Spacelab data analysis; San Marco activity; Molecular physics; Stellar energy analysis; Troposphere data analysis; Voyager encounter analysis;

Laser activity; Gravity wave study; Venus studies; and Shuttle environmental studies. E.R.

N87-22332*# Washington Univ., Seattle. Space Science Div.
ELECTRODYNAMICS OF THE MIDDLE ATMOSPHERE: SUPERPRESSURE BALLOON PROGRAM Final Report
Robert H. Holzworth Apr. 1987 50 p
(Grant NAGw-724)
(NASA-CR-180600; NAS 1.26:180600) Avail: NTIS HC A03/MF A01 CSCL 04A

In this experiment a comprehensive set of electrical parameters were measured during eight long duration flights in the southern hemisphere stratosphere. These flight resulted in the largest data set ever collected from the stratosphere. The stratosphere has never been electrodynamically sampled in the systematic manner before. New discoveries include short term variability in the planetary scale electric current system, the unexpected observation of stratospheric conductivity variations over thunderstorms and the observation of direct stratospheric conductivity variations following a relatively small solar flare. Major statistical studies were conducted of the large scale current systems, the stratospheric conductivity and the neutral gravity waves (from pressure and temperature data) using the entire data set. Author

N87-22333# Rome Univ. (Italy). Dipt. di Fisica.
PROPOSAL OF AN EXPERIMENT FOR THE SEARCH OF A FORCE OF BARYONIC ORIGIN
E. Amaldi, R. Bizzarri, A. Degasperis, G. Muratori, G. V. Pallottino, G. Pizzella, M. Price, F. Ricci, and C. Rubbia (European Organization for Nuclear Research, Geneva, Switzerland) 27 May 1986 31 p
(Nota-Interna-866; ETN-87-99759) Avail: NTIS HC A03/MF A01

A baryonic force detector experiment which does not use the Earth but man made source and detector is proposed. The experiment should be able to detect the existence of any force not proportional to the inertial mass with a relative accuracy of 0.00001, independent of the value of lambda, provided it is bigger than the dimensions of the apparatus, i.e., a few meters. The proposal is based on the use of the cryogenic gravitational wave antenna of the Rome group as detector of the near field generated by a source consisting of a rotor which turns at the resonance frequency of the antenna (915 Hz). ESA

N87-22334# Institut d'Aeronomie Spatiale de Belgique, Brussels.
REMOTE SENSING OZONE MEASUREMENTS FROM STRATOSPHERIC BALLOON DURING MAP/GLOBUS CAMPAIGN 1983
P. C. Simon, W. Peetermans, E. Plateau, P. Rigaud, J.-P. Naudet, D. Huguenin, D. Offerman, and H. Rippel (Wuppertal Univ., West Germany) 1986 27 p Sponsored by Bundesministerium fuer Forschung und Technologie, CNRS, and CNES
(Aeronomica-Acta-A-314-1986; ISSN-0065-3713; ETN-87-99844) Avail: NTIS HC A03/MF A01

Remote sensing measurements of ozone in ultraviolet, visible, and infrared domains by stratospheric balloons are discussed. Ozone concentrations deduced from planet and solar occultation measurements in the Huggins and Chappuis absorption bands are given with an uncertainty of + or - 10%. Results obtained from absorption measurement in the Chappuis bands give systematically higher concentration values than those deduced from in situ techniques. Discrepancies of the order of 20% are found between 24 and 34 km altitude. They are larger below the ozone maximum and above 35 km. Analysis shows an aerosol contribution in the measured optical depth in the Chappuis bands, for altitude below 28 km, giving overestimated inferred ozone concentrations. Discrepancies at higher altitudes with in situ soundings are difficult to explain. ESA

N87-22335# National Geodetic Survey, Rockville, Md.
NATIONAL GEODETIC SURVEY GRAVITY NETWORK
R. E. Moose Dec. 1986 38 p
(PB87-151932; NOAA-TR-NOS-121; NGS-39) Avail: NTIS HC A03/MF A01 CSCL 08E

In 1966, the U.S. National Gravity Base Network was established through the cooperative efforts of several government agencies and academic institutions involved in nationwide gravity observations. The network was reobserved between 1975 and 1979 by the National Geodetic Survey (NGS) using field procedures designed to give high-quality gravity differences. The report discusses the adjustment and the areas where apparent gravity change was observed. NGS plans to densify and maintain this network and to improve the accuracy of the station values by additional high-quality relative ties and by making observations with a new, absolute gravity meter in each of the states. GRA

N87-22336# Missouri Univ., Columbia. Cooperative Inst. for Applied Meteorology.
A REVIEW OF NATIONAL AND INTERNATIONAL ACTIVITIES ON MODELING THE EFFECTS OF INCREASED CO2 CONCENTRATIONS ON THE SIMULATION OF REGIONAL CROP PRODUCTION: A REPORT ON LINKAGE BETWEEN CLIMATE AND CROP MODELS Progress Report
W. L. Decker and R. Achutuni 1 Jan. 1987 47 p
(Contract DE-FG02-86ER-60444)
(DE87-005994; DOE/ER-60444/T1) Avail: NTIS HC A03/MF A01

General circulation models have been used to estimate the probable changes in climate due to increased levels of carbon dioxide. These models, generally, project increases in the mean surface temperatures; but changes in precipitation due to CO2 enrichment are not as clear. Some process models, which utilize a minimum amount of empiricism, can be adopted for use in studying the impacts of both climate change scenarios and the direct effects of CO2 fertilization. The CERES-Maize, CERES-Wheat, SORGF, GLYCIM, and SOYGRO are among those classified for this use. A great deal of effort is directed toward these developments. WMO/UNEP/ICSU has sponsored at least two European meetings but with only limited success for testing production models. A similar effort has been conducted by the Commission of European Communities. An attempt has been made to modify the CERES models, which have been used in climate studies, for use in simulation of the direct effects. Initial simulations involving this modification, show that doubling CO2 will increase corn production 12 to 30% at locations in northern Illinois for the four-year period 1982 to 1985. Photosynthesis influenced yields more than decreased transpiration. DOE

N87-22337# Los Alamos National Lab., N. Mex.
A SIMPLE THEORY OF CLOUD SPREADING AT RANGES FROM 1-2000 km
F. A. Gifford 1987 16 p Presented at the 16th International Technical Meeting on Air Pollution Modelling and Its Application, Lindau, West Germany, 6 Apr. 1987
(Contract W-7405-eng-36)
(DE87-006067; LA-UR-87-678; CONF-870444-1) Avail: NTIS MF A01

Examples support the conclusion that cloud or plume spreading in the troposphere proceeds rapidly and rather steadily for times on the order of a day or two and to distances of several hundreds of kilometers. Subsequently, the cloud begins to develop a streaky structure under the influence of the large-scale, enstrophy-cascade range of motions. The GASP spectra indicate that the transition between these two modes of spreading begins at several hundred kilometers and is well developed by about 1000 km, in terms of spectral wavelength. The cloud streaks and patches elongate rapidly, evidently at the exponential rate, but spread laterally more slowly, at a rate that represents the effects of the conservation of cloud area under large-scale deformation and the lateral diffusion at the asymptotic rate. Although this relative diffusion occurs at a comparatively slow rate, it is very effective in reducing cloud concentrations in combination with the rapid, large-scale cloud stretching by the 2-D, enstrophy-cascade range eddies. The LANL heavy-methane cloud data indicate that the net result is very rapid

decay of cloud concentration, apparently at an exponential rate. DOE

N87-22338# Ohmstede (William D.), Las Cruces, N. Mex.
CONTINUED CONTRIBUTIONS TO LARGE-EDDY SIMULATION
W. D. Ohmstede Dec. 1986 106 p Prepared in cooperation with Lawrence Livermore National Lab., CA.
(Contract W-7405-eng-48)
(DE87-007328; UCRL-15893) Avail: NTIS HC A06

The report summarizes work done in support of the large-eddy simulation (LES) project. Particular attention was paid to the bottom boundary conditions and optimum discretization of equations in the vicinity of the bottom boundary. The work was subdivided into four related tasks: (1) LES parameterization and initialization; (2) air/earth interaction; (3) numerical optimization; and (4) analysis and interpretation. DOE

N87-22109*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH RESOLUTION INFRARED SPECTROSCOPY FROM SPACE: A PRELIMINARY REPORT ON THE RESULTS OF THE ATMOSPHERIC TRACE MOLECULE SPECTROSCOPY (ATMOS) EXPERIMENT ON SPACELAB 3
Crofton B. Farmer and Odell F. Raper *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 42-62 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

N87-22110*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AURORAL IMAGES FROM SPACELAB 3
Thomas J. Hallinan (Alaska Univ., Fairbanks.) and Don Lind *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 63 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

N87-22111*# Tata Inst. of Fundamental Research, Bombay (India).
IONS (ANURADHA): IONIZATION STATES OF LOW ENERGY COSMIC RAYS
S. Biswas, R. Chakraborti, R. Cowsik, N. Durgaprasad, P. J. Kajarekar, R. K. Singh, M. N. Vahia, J. S. Yadav, N. Dutt, J. N. Goswami (Physical Research Lab., Ahmedabad, India) et al. *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 64-74 Prepared in cooperation with Physical Research Lab., Ahmedabad, India, and ISRO Satellite Centre, Peenya, Bangalore, India (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 04A

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N87-22339# Air Force Global Weather Central, Offutt AFB, Nebr.
AFGWC (AIR FORCE GLOBAL WEATHER CENTRAL) SNOW ANALYSIS MODEL Final Report
Samuel J. Hall 28 Feb. 1986 30 p Supersedes AFGWC-TM-75-1
(AD-A176202; AFGWC/TN-86/001; AFGWC-TM-75-1) Avail: NTIS HC A03/MF A01 CSCL 04B

The Air Force Global Weather Central (AFGWC) Snow Analysis Model, which generates daily snow age and depth analyses, has been operational since March 1975 for the Northern Hemisphere and since October 1975 for the Southern Hemisphere. The snow analysis (SNODEP) model uses the latest observations (surface synoptic reports), snow and ice climatology, time continuity and manual updates. This makes it possible to produce very good measures of snow extent and reasonable snow depth values at all grid points over the land and the ice-covered areas of the Earth, regardless of the availability of surface observations. The method of analysis, a technique used to infer snow age, and some problems associated with the input data are described. Although the model is tailored to satisfy specific AFGWC requirements, other potential applications are discussed. GRA

N87-22340# Naval Postgraduate School, Monterey, Calif.
COMPARISON OF WESTERN NORTH PACIFIC TROPICAL CYCLONE AIDS USING STORM-RELATED AND SYNOPTIC PARAMETERS M.S. Thesis
Henry Jones Dec. 1986 141 p
(AD-A176702) Avail: NTIS HC A07/MF A01 CSCL 04B

The performance of four western North Pacific Ocean objective aids (One-way influence Tropical Cyclone Model-OTCM; Recurver analog-REC; Total analog-TOTL; and 500 mb steering-CY50) is evaluated using mean forecast error (MFE), systematic error and cross-track (CT) and along-track (AT) statistics. Stratification of these errors by storm-related (latitude, longitude, intensity, 12-h intensity change and size) and synoptic parameters through empirical orthogonal functions (700 mb easterlies/250 mb trough, 700 mb westerlies/250 mb trough, 700 mb easterlies/250 mb ridge, 700 mb westerlies/250 mb ridge) distinguishes between different conditions associated with tropical cyclone motion. The systematic and CT/AT error results reveal distinct biases for each objective aid: (1) OTCM (short-range rightward/slow and long-range leftward/fast); (2) REC (rightward/fast); (3) TOTL (leftward/fast); and (4) CY50 (rightward/slow). The OTCM has the best performance as a result of a small systematic bias. The REC analog has large forecast errors on left-turning and straight-moving storms due to its selection of only recurving analogs. The selection of analogs from the total sample (TOTL) results in errors due to missed recurvature forecasts. Finally, the CY50 has the worst long-range skill because of the lack of the physics of OTCM and climatology influence of the analog techniques. GRA

N87-22341*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ATMOSPHERIC TURBULENCE RELATIVE TO AVIATION, MISSILE, AND SPACE PROGRAMS
Dennis W. Camp, ed. and Walter Frost, ed. (FWG Associates, Inc., Tullahoma, Tenn.) Apr. 1987 257 p Workshop held in Hampton, Va., 2-4 Apr. 1986
(NASA-CP-2468; L-16296; NAS 1.55:2468) Avail: NTIS HC A12/MF A01 CSCL 04B

The purpose of the workshop was to bring together various disciplines of the aviation, missile, and space programs involved in predicting, measuring, modeling, and understanding the processes of atmospheric turbulence. Working committees re-examined the current state of knowledge, identified present and future needs, and documented and prioritized integrated and cooperative research programs. For individual titles, see N87-22342 through N87-22355.

N87-22342*# National Transportation Safety Board, Washington, D. C.
COMMENTS ON THE PROBLEM OF TURBULENCE IN AVIATION **c03**
James C. McLean, Jr. *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 11-16 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

The problem of turbulence since the beginning of aviation is traced. The problem was not cured by high altitude flight and was acerbated by the downbursts associated with thunderstorms. The accidents that occurred during the period 1982 to 1984 are listed. From this is extracted the weather related accidents. Turbulence accounts for 24% of the accidents involving large commercial carriers and 54% of the weather related accidents. In spite of all the efforts to improve the forecasting and detection of turbulence, the problem is still a large one. E.R.

N87-22343*# Air Force Inspection and Safety Center, Norton AFB, Calif.
DOD (USAF) TURBULENCE ACCIDENTS AND INCIDENTS **c03**
Douglas Miller *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 17-25 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

A summary of Air Force turbulence related mishaps for the last ten years of Air Force mishaps is presented from a perspective of where it has been, where it is now, and where it is going. In addition to accounts of major mishaps, a summary of what actions were taken to preclude future similar mishaps is presented. Also, a discussion of some of the things being done now and being planned for the future to prevent turbulence related mishaps is presented. Author

N87-22344*# Douglas Aircraft Co., Inc., Long Beach, Calif.
NEW GENERATION AIRCRAFT DESIGN PROBLEMS RELATIVE TO TURBULENCE STABILITY, AEROELASTIC LOADS AND GUST ALLEVIATION **c05**
Richard M. Heimbaugh *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 27-45 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 01C

Past history, present status, and future of discrete gusts are schematically presented. It is shown that there are two approaches to the gust analysis: discrete and spectral density. The role of these two approaches to gust analysis are discussed. The idea of using power spectral density (PSD) in the analysis of gusts is especially detailed. E.R.

N87-22345*# Army Missile Lab., Redstone Arsenal, Ala.
TACTICAL MISSILE TURBULENCE PROBLEMS **c15**
Richard E. Dickson *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 47-51 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 16D

Of particular interest is atmospheric turbulence in the atmospheric boundary layer, since this affects both the launch and terminal phase of flight, and the total flight for direct fire systems. Brief discussions are presented on rocket artillery boost wind problems, mean wind correction, turbulent boost wind correction, the Dynamically Aimed Free Flight Rocket (DAFFR) wind filter, the DAFFR test, and rocket wake turbulence problems. It is concluded that many of the turbulence problems of rockets and missiles are common to those of aircraft, such as structural loading and control system design. However, these problems have not been solved at this time. E.R.

N87-22346*# FWG Associates, Inc., Tullahoma, Tenn.
REMOTE VERSUS IN SITU TURBULENCE MEASUREMENTS
Walter Frost *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 53-71 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

Comparisons of in situ wind and turbulence measurements made with the NASA B-57 instrumented aircraft and those remotely made with both radar and lidar systems are presented. Turbulence measurements with a lidar or radar system as compared with those from an aircraft are the principal themes. However, some discussion of mean wind speed and direction measurements is presented. First, the principle of measuring turbulence with Doppler lidar and radar is briefly and conceptually described. The comparisons with aircraft measurements are then discussed. Two studies in particular are addressed: one uses the JAWS Doppler radar data and the other uses data gathered both with the NASA Marshall Space Flight Center and the the NOAA Wave Propagation Lab. gound based lidars. Finally, some conclusions and recommendations are made. Author

N87-22347*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MEASUREMENTS OF ATMOSPHERIC TURBULENCE
Harold N. Murrow *In its* Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 73-92 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

Various types of atmospheric turbulence measurements are addressed for the purpose of stimulating discussion relative to available data. An outline of these various types of measurements are discussed. Some specific results of detailed characterization studies made at NASA Langley are emphasized. The most recent reports on statistics of turbulence encounters for various types of aircraft operations are summarized. Special severe encounter studies and reference to remote sensing are also included. Wind shear is considered to be a special topic and is not covered. Author

N87-22348*# National Severe Storms Lab., Norman, Okla.
TURBULENCE AS OBSERVED BY CONCURRENT MEASUREMENTS MADE AT NSSL USING WEATHER RADAR, DOPPLER RADAR, DOPPLER LIDAR AND AIRCRAFT
Jean T. Lee *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 93-110 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

As air traffic increases and aircraft capability increases in range and operating altitude, the exposure to weather hazards increases. Turbulence and wind shears are two of the most important of these hazards that must be taken into account if safe flight operations are to be accomplished. Beginning in the early 1960's, Project Rough Rider began thunderstorm investigations. Past and present efforts at the National Severe Storm Laboratory (NSSL) to measure these flight safety hazards and to describe the use of Doppler radar to detect and qualify these hazards are summarized. In particular, the evolution of the Doppler-measured radial velocity spectrum width and its applicability to the problem of safe flight is presented. Author

N87-22349*# California Univ., Los Angeles.
CAT-GENERATING MECHANISMS
Morton G. Wurtele *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 111-126 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

The development of instability configurations; the transition from unstable growth of these configurations into turbulence; a description of the nature of that turbulence; the question of decay of turbulence; and the existence of what is called fossil turbulence are discussed. Author

N87-22350*# National Aeronautics and Space Administration, Washington, D.C.
PHYSICAL MECHANISMS OF HEAT, MOMENTUM AND TURBULENCE FLUXES
John S. Theon *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 127-135 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

In a qualitative way, the physical mechanisms which generate fluxes of heat, momentum, and turbulence in the atmosphere are discussed. This material is presented to acquaint people with the Earth science aspects of turbulence as important processes in the atmosphere. To attempt to describe turbulent fluxes of heat, momentum, and moisture in precise mathematical detail becomes an intractable problem. It is burdened by an eighth order set of equations involving more variables than equations. It is a closure problem which requires complicated assumptions that are not necessarily always satisfied, variable boundary conditions, and sparse observational data. Therefore, we must approach the problem in a simplified manner to obtain any kind of solution involving the variables of shear, stress, and heat, moisture, and

momentum fluxes. There are other problems, of course, in which the inclusion of the planetary boundary layer is extremely important. Air pollution studies, air-sea exchanges, mesoscale models, and so on, must account for the planetary layer in very specific terms. Some of the physical mechanisms that are involved in generating fluxes are described. Author

N87-22351*# Delta Air Lines, Inc., Atlanta, Ga.
TURBULENCE FORECASTING
C. L. Chandler *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 137-154 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

In order to forecast turbulence, one needs to have an understanding of the cause of turbulence. Therefore, an attempt is made to show the atmospheric structure that often results when aircraft encounter moderate or greater turbulence. The analysis is based on thousands of hours of observations of flights over the past 39 years of aviation meteorology. Author

N87-22352*# Naval Environmental Prediction Research Facility, Monterey, Calif.
TRANSPORT MODELS FOR NUMERICAL FORECAST
Stephen D. Burk *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 155-158 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

The explosive growth of computing power, coupled with scientific and technological emphasis on a national scale, has led to significant major advances in operational numerical weather prediction (NWP) during the last two decades. There are about half a dozen major centers around the world running global NWP models operationally. Many more countries have operational hemispheric or limited-area models which provide weather forecasts. The global models typically have several hundred kilometer resolution, while the limited-area models usually have horizontal spacing of 50 to 100 km. Given the pace of burgeoning growth in this area, it seems warranted to occasionally take an overview of aspects of the field common to all modelers. Here, a brief look is taken at the nature of subgrid scale turbulence transport parameterization, and some of the difficulties pertaining thereto, with particular emphasis on operational NWP models. Author

N87-22353*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EXAMPLE ON HOW TO MODEL AND SIMULATE TURBULENCE FOR FLIGHT SIMULATORS
John C. Houbolt *In its* Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 159-178 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

Analytical developments relative to gust response are discussed. Turbulence length scale, spectral functions, zero crossing values, gust loads analysis, power spectral techniques for analyzing the response of aircraft in turbulence, the spectrum of the rolling moment coefficient, and the spectrum correction factor are among the issues considered. R.J.F.

N87-22354*# United Air Lines, Inc., Denver, Colo.
IMPLEMENTATION OF TURBULENCE MODELS INTO SIMULATORS **c09**
Robert L. Ireland *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 179-180 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 14B

Simulation of turbulence as it relates to the flight training environment is discussed in general terms. Simulators that put random white noise into the system and simulators that put random motion into the equations of motion are discussed, as are simulators that incorporate pitch and roll moments into vertical turbulence. Wind shear models and simplified models of microburst phenomena are covered. R.J.F.

N87-22355*# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
THE STATUS OF MILITARY SPECIFICATIONS WITH REGARD TO ATMOSPHERIC TURBULENCE
David J. Moorhouse and Robert K. Heffley (Manudyne Systems, Inc., Los Altos, Calif.) *In* NASA. Langley Research Center Atmospheric Turbulence Relative to Aviation, Missile and Space Programs Apr. 1987 p 181-199 (For primary document see N87-22341 15-47)
Avail: NTIS HC A12/MF A01 CSCL 04B

The features of atmospheric disturbances that are significant to aircraft flying qualities are discussed. Next follows a survey of proposed models. Lastly, there is a discussion of the content and application of the model contained in the current flying qualities specification and the forthcoming MIL-Standard. Author

N87-22356# Regione del Veneto, Mestre-Venezia (Italy). Centro Sperimentale Valanghe e difesa Idrogeologica.
DYNAMIC CLIMATOLOGY OF THE TYPES OF WEATHER OVER THE VENICE REGION [CLIMATOLOGIA DINAMICA DEI TIPI DI TEMPO SUL VENETO]
Sergio Borghi 1986 59 p In ITALIAN
(ETN-87-99357) Avail: NTIS HC A04/MF A0

The weather around Venice is analyzed, based on the classification of weather types made at a European scale. The specific weather data of the concerned region are used to integrate a model, correlating both types of information. The analyses of cyclonic and anticyclonic circulation are mapped. The distribution and intensity of precipitation and the evolution of temperature are also included in the model. ESA

N87-22357# Regione del Veneto, Mestre-Venezia (Italy). Centro Sperimentale Valanghe e difesa Idrogeologica.
STUDY OF HIGH INTENSITY RAINS IN VENICE REGION MOUNTAIN AREAS [STUDIO SULLE PIOGGE INTENSE NEL TERRITORIO MONTANO DELLA REGIONE VENETO]
31 Jul. 1985 149 p In ITALIAN; ENGLISH summary
(Quad-Ric-2; ETN-87-99358) Avail: NTIS HC A07/MF A01

The annual maxima data of 55 weather stations in the period 1921-1980 were studied, considering integration intervals from 15 min to 24 hr. The distribution models were tested, finding a better adaptation of data to the log normal representation. The design precipitation, corresponding to fixed probability values are computed. ESA

N87-22358# Manchester Univ. (England). Dept. of Physics.
A STUDY OF THE IDENTIFICATION AND DEVELOPMENT OF PRECIPITATION USING DUAL POLARIZATION RADAR Final Report, Apr. 1985 - May 1986
Anthony J. Illingworth 30 Jun. 1986 64 p
(Grant AF-AFOSR-0188-85)
(AD-A177280; AFOSR-87-0010TR) Avail: NTIS HC A04/MF A01 CSCL 17I

Dual polarization radar measures the shape of precipation particles within clouds. Analysis of such radar data is described in three papers. The first paper summarises a method which enables hail to be identified by radar for the first time. The exact shape of large raindrops in heavy rain is not known precisely, but is needed for radar estimates of rainfall, and the second paper, based on a statistical analysis of radar data, deduces that they are more oblate than previously suggested. The third paper concludes that large supercooled raindrops, rather than ice, are present in rapidly developing convective clouds. Work to be carried out in the summer and fall of 1986 is outlined. GRA

N87-22359# Danish Meteorological Inst., Copenhagen.
OBSERVED WIND SPEED AND CROSS ISOBARIC ANGLE OVER ORESUND IN RELATION TO GEOSTROPHIC WIND, STABILITY AND BAROCLINITY
Klaus Hedegaard 1986 49 p
(WSR-7; ISBN-87-7478-278-9) Avail: NTIS HC A03/MF A01

An explicit form of the resistance law for the transport of momentum through the atmospheric boundary layer is developed

for diabatic and baroclinic conditions over the sea, where the roughness of the surface cannot be considered an external parameter, contrary to the base with a fixed lower boundary. The momentum fluxes are obtained from ordinary routine wind observations and external variables. The thermal stability in the surface boundary layer is determined from the external stability parameter based on the fixed upper reference height of 675 m, using the assumption that the transfer coefficients for heat and momentum through the atmospheric boundary layer are approximately equal. From this general resistance law, the wind speed at an arbitrary height within the surface boundary layer may be calculated from the external variables. The such determined wind speeds were found in satisfactory agreement with published analyses of surface wind speeds in relation to geostrophic wind speeds. An explicit expression for the cross isobaric angle in diabatic and baroclinic conditions is also developed. Author

N87-22360# Naval Research Lab., Washington, D. C.
A COMPUTER PROGRAM TO CALCULATE PSYCHROMETRIC QUANTITIES Final Report
Joseph M. Londino 30 Jan. 1987 32 p
(AD-A177416; NRL-MR-5890) Avail: NTIS HC A03/MF A01 CSCL 09B

This report describes a FORTRAN 77 program that calculates moist air properties. Using the barometric pressure and either dry-bulb temperature and relative humidity, or dry-bulb temperature and wet-bulb temperature as input this program will calculate the dry-bulb temperature, wet-bulb temperature, dew point, enthalpy, relative humidity, humidity ratio, specific volume, and viscosity. GRA

N87-22361 Wisconsin Univ., Madison.
AUTOMATED RECOGNITION OF OCEANIC CLOUD PATTERNS AND ITS APPLICATION TO REMOTE SENSING OF METEOROLOGICAL PARAMETERS Ph.D. Thesis
Louis Joseph Charles Garand 1986 249 p
Avail: Univ. Microfilms Order No. DA8628663

A scheme is presented for the automated classification of oceanic cloud patterns in twenty classes. A training set is defined by 2000 samples of size 128 x 128 km taken in February 1984 over the Western Atlantic. The method used visible and infrared images from a geostationary satellite. Class discrimination is obtained from thirteen features representing height, aldedo, shape and multi-layering characteristics. Features derived from the two-dimensional power spectrum of the visible images proved essential for the detection of directional pattern (streets, rolls) and open cells. A simple classification algorithm is developed based on the assumption of multivariate normal distributions of the features. From 1020 independent samples, the consensus among three expert nephanalysts is an overall accuracy of 79% with the machine answer at least second best 89% of the time. The cloud climatology in twenty classes for January and February 1984 are compared. Dissert. Abstr.

N87-22362# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
FORECAST OF ATLANTIC SEASONAL HURRICANE ACTIVITY FOR 1987
William M. Gray 1987 28 p
Avail: NTIS HC A03/MF A01

The forecast of the amount of tropical cyclone activity which might be expected to occur in the Atlantic Ocean region (including the Caribbean Sea and the Gulf of Mexico) in 1987 is discussed. The forecast is based on the author's previous and current research which relates seasonal amount of Atlantic tropical cyclone activity to four factors: (1) the El Nino (EN); (2) the Quasi-Biennial Oscillation of equatorial stratospheric wind (QBO); (3) Caribbean Basin and Gulf of Mexico Sea Level Pressure Anomaly (SLPA); and (4) lower latitude Caribbean Basin 200 mb zonal wind anomaly in June and July. Information indicates that the 1987 hurricane season can be expected to have about 5 hurricanes, 8 total name storms of both hurricanes and tropical storm intensity, and about 20 hurricane days. This means that the 1987 Atlantic hurricane season can be expected to be a slightly below average season based on conditions of the last 17 years. A background description of the methodology of this objective forecast scheme is given along with verification information on the forecasts for the 1984 to 1986 seasons. Author

N87-22363# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
ENERGY BALANCE OF THE TROPICAL SYSTEMS (BEST). CONFERENCE ON THE SCIENTIFIC PROSPECTS OF THE PROJECT [SEMINAIRE DE PROSPECTIVE SCIENTIFIQUE SUR LE PROJET BEST (BILAN ENERGETIQUE DU SYSTEME TROPICAL)]
1986 231 p In FRENCH Proceedings of the Colloque de Prospective du CNES, Deauville, France, Oct. 1985
Prepared in cooperation with CNRS, Orleans, France, Lab. de Meteorologie Dynamique du CNRS, Palaise au, France, and Lille-1 Univ., Villeneuve-d'Asoq, France
(ETN-87-99367) Avail: NTIS HC A11/MF A01

Clouds and precipitation; measurement of liquid water detection; radar measurement of ground precipitation; multichannel radiometry measurement of water vapor concentration and vertical profiles; lidar measurement of moisture, temperature, and pressure; methods of determination of surface flows; water balances; and windfield measurement using Doppler lidar are discussed. For individual titles, see N87-22364 through N87-22373.

N87-22364# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
MEASUREMENT AND DETECTION OF PRECIPITATION. SATELLITE METHODS IN THE VISIBLE AND THE INFRARED [DETECTION ET MESURE DES PRECIPITATIONS. METHODES SATELLITAIRES EN VISIBLE ET EN INFRAROUGE]
Michel Desbois *In its* Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 5-10 In FRENCH (For primary language document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

The utilization of combined visible and infrared precipitation measurements is discussed. The application to the study of space-time distribution of large scale rain is reviewed, in particular the phenomena associated with El Nino. It is concluded that there is not a simple universal method that can be applied to any type of cloud, any region, any season. Local measurements are necessary in each case to calibrate the measuring system. ESA

N87-22365# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
LIQUID WATER MEASUREMENT USING HYPERFREQUENCY RADIOMETRY [MESURE DE L'EAU LIQUIDE PAR RADIOMETRIE HYPERFREQUENCE]
R. Bernard *In its* Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 11-33 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

Atmospheric transmission and absorption spectra, scattering efficiency factors, and correlation between brightness temperature, rain rate, and freezing level are discussed. It is shown that for suspended water measurements, 3 channels are enough (18, 21 and 36 GHz) and that algorithms are already available. The method is also well adapted to detect and map the precipitation areas, with a rough estimation of precipitation rate. ESA

N87-22366# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
REMOTE SENSING CLOUD STUDY USING ACTIVE LIDAR [ETUDE DES NUAGES PAR TELEDETECTION ACTIVE LIDAR]
Pierre H. Flamant *In* Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 35-48 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

Lidar remote sensing principles and applications are presented, including backscattering lidar detection and resolution capacity, cloud altitude and morphology discrimination, cloud optical properties and microphysics, and spaceborne lidar observation. Space programs are mentioned, including BEST, LITE, LASA and ATLID missions. ESA

N87-22367# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
RADAR UTILIZATION AND GROUND PRECIPITATION MEASUREMENT NETWORKS [UTILISATION DES RADARS ET RESEAUX DE MESURE DES PRECIPITATIONS AU SOL]
Paul Amayenc *In its* Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 49-103 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

The essential elements of radar measurement of precipitations are recalled. The main methods to estimate rain rate from ground operating radar data are reviewed. The design and operation principles of satellite-borne radars are discussed. The use of two wavelengths and two polarizations is analyzed. The sampling and calibration problems are examined. ESA

N87-22368# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
MEASUREMENT OF WATER VAPOR AND TEMPERATURE: CONCENTRATION AND PROFILES USING MULTICHANNEL RADIOMETRY (MICROWAVE AND INFRARED) [MESURES DE LA VAPEUR D'EAU ET DE LA TEMPERATURE: CONTENU ET PROFILS PAR RADIOMETRIE MULTICANAUX (MICRO-ONDES ET INFRA-ROUGE)]
A. Chedin *In* Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 107-118 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

The potential and characteristics of the TIROS operational vertical sounder (TOVS) onboard the TIROS-N series satellites are discussed. The sampling frequency and the horizontal resolution are detailed. The contribution of each channel to sound a particular atmospheric region is explained, showing that the penetration of microwaves which pass through cloud regions is a key design factor. The three dimensional analysis of the atmosphere and the use of the improved initialization algorithm starting from satellite vertical profile data are described. ESA

N87-22369# Centre National de la Recherche Scientifique, Orleans (France). Service d'Aeronomie.
MEASUREMENT OF HUMIDITY, TEMPERATURE, AND PRESSURE BY LIDAR [MESURES DE L'HUMIDITE, DE LA TEMPERATURE, DE LA PRESSION PAR LIDAR]
J. Pelon *In* Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 119-125 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

Vertical profiles of atmospheric parameters were measured by a laser differential absorption method. Two laser pulses are emitted at two different wavelengths, such that one is attenuated by a given parameter, and the other is not. Experimental measurements are reviewed. The limits of accuracy and resolution attainable from satellite observation are given. ESA

N87-22370# Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
SURFACE FLOW: ACTIVE AND PASSIVE DETERMINATION METHODS, MICROWAVES, AND INFRARED/VISIBLE [LES FLUX DE SURFACE: METHODES DE DETERMINATION ACTIVES ET PASSIVES, MICROONDE ET INFRAROUGE/VISIBLE]
Laurence Eymard and Alain Weill *In* Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 127-152 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

Mass and energy flow measurement methods are studied including local flow measurement methods and instruments, such as cospectral methods, inertial methods, and average profile parameterization; and methods using satellite observation data, such as the Sarachik analysis of geographical flow distribution, thermal and water parameter measuring over the continents, thermal flow over land masses, measurement of atmospheric parameters over the ocean, and ocean regions heat flow. The insufficiencies of the atmospheric models as well as the inadequate accuracy of satellite data are demonstrated. ESA

N87-22371# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
WATER BALANCE AND WATER TRANSPORT: THE INTEREST IN MODELING AND THE CONTRIBUTIONS OF THE ENERGY BALANCE OF THE TROPICAL SYSTEM (BEST) PROJECT [BILAN HYDRIQUE, TRANSPORTS: INTERET POUR LA MODELISATION ET APPORT DU PROJET BEST]
Robert Sadourny *In its* Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 153-161 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

Hydrodynamic models are discussed, showing that model imperfections may produce absurdities such as two widely different predictions when changing the transport algorithm. The application of variational techniques is discussed, suggesting that they may become operational in few years, and thus overcoming some of the model imperfections. The necessity of a climatology of atmospheric flows is affirmed. Models of cloud dynamics must be developed. ESA

N87-22372# Laboratoire de Meteorologie Dynamique du CNRS, Palaiseau (France).
STUDY OF WIND FIELDS USING DOPPLER LIDAR [ETUDE DU CHAMP DE VENT PAR LIDAR DOPPLER]
Pierre H. Flamant *In* Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects of the Project 1986 p 165-179 In FRENCH (For primary document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

The principles of Doppler lidar measurement of wind velocity are reviewed, and the method is compared to others, such as radio sounding. Studies carried out to develop a satellite-borne system are described. It is shown that Doppler lidar is useful and may be necessary to study global wind fields. ESA

N87-22373# Centre de Recherches en Physique de l'Environnement Terrestre et Planetaire, Orleans (France).
ENERGY BALANCE OF THE TROPICAL SYSTEMS (BEST): A SPACE EXPERIMENT PROPOSITION [PROJET D'EXPERIENCE SPATIALE 'BEST'. BILAN ENERGETIQUE DU SYSTEME TROPICAL]
P. Amayenc, R. Bernard, L. Eymard, J. Testud, D. Vidal-Madjar, G. Megie, J. Pelon, J. P. Jegou, J. Barat, P. Flamant (Ecole Polytechnique, Palaiseau, France) et al. *In its* Energy Balance of the Tropical Systems (BEST). Conference on the Scientific Prospects on the Project 1986 p 183-217 In FRENCH (For primary

document see N87-22363 15-47)
Avail: NTIS HC A11/MF A01

A satellite-borne system to measure tropical region atmospheric parameters is proposed. The instruments include active and passive microwave radars, optical radar, and infrared radiometry. The main parameters to be measured are precipitation intensity, ocean or ground interfaces, evaporation flow, water vapor distribution, and integrated suspended liquid water content. The vertical temperature profile is also measured. A project expansion to Doppler lidar wind velocity measurement is also discussed. Instrument technical characteristics are described. ESA

N87-22374# National Severe Storms Forecast Center, Kansas City, Mo.
EXAMINATION OF THE NATIONAL WEATHER SERVICE SEVERE LOCAL STORM WARNING PROGRAM AND PROPOSED IMPROVEMENTS
J. E. Hales Jan. 1987 39 p
(PB87-147948; NOAA-TM-NWS-NSSFC-15) Avail: NTIS HC A03/MF A01 CSCL 04B

The National Weather Service uses verification algorithms to evaluate the quality of its severe local storm watch and warning service. With the increased emphasis in recent years on verification many weather service offices have taken steps to better their statistics. Some have developed improved warning techniques, others have developed post-storm survey procedures. Problems that can result, such as an unrepresentative severe local storm climatology and misleading verification statistics are discussed. Stratification of severe local storm events by intensity prior to using these data in verification of watches/warnings provides a more realistic measure of the effectiveness of the warning service. Examples of resulting statistics and possible applications are presented. GRA

N87-22375# National Weather Service, Garden City, N.Y.
WASHINGTON METROPOLITAN WIND STUDY, 1981-1986
C. Burke and C. C. Ewald Feb. 1987 30 p
(PB87-151908; NOAA-TM-NWS-ER-71) Avail: NTIS HC A03/MF A01 CSCL 04B

The importance of wind direction and speed in the designation of the operational runway was the basis for this study. During the past five years from October 1, 1981, until October 7, 1986, almost 37,100 hourly wind observations from National (DCA), Dulles (IAD, Baltimore-Washington (BWI) and Andrews (ADW) airports were examined and 2013 observations or 5.4%, which met one of the 3 criteria listed below, were recorded. The study is divided into a separate section for each criterion. It is hoped that the results of the study represented by the numerous tables will improve the operational wind forecasts for these airports made by the Leesburg CWSU Meteorologists at the beginning of every shift. GRA

N87-22376# North American Weather Consultants, Inc., Salt Lake City, Utah.
CLOUD SEEDING, DATA COLLECTION AND ANALYSIS ASSOCIATED WITH THE COLORADO RIVER AUGMENTATION DEMONSTRATION PROGRAM, 1985-86 SEASON Interim Progress Report, Oct. 1985 - Sep. 1986
J. R. Thompson Dec. 1986 114 p Sponsored by Bureau of Reclamation
(Contract DI-5-CR-81-05090)
(PB87-152047; WM-86-7) Avail: NTIS HC A06/MF A01 CSCL 04B

Limited experimental cloud seeding was conducted for the first time as a part of the Colorado River Augmentation Demonstration Program (CRADP) during the 1985 to 1986 winter season. The cloud seeding occurred over the Grand Mesa region of Western Colorado. Seeding activities, which included aerial and ground releases of silver-iodide-ammonium iodide-acetone, were associated with three research studies, i.e., microphysical experiments, transport and dispersion of seeded plumes, and systems reliability testing of a new prototype cloud seeding generator. GRA

N87-22377# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
PROGRAM OF FEDERAL/STATE/LOCAL COOPERATIVE WEATHER MODIFICATION RESEARCH: DESIGN CONSIDERATION. PART 1: HYPOTHESIS DESCRIPTION AND ASSESSMENT Final Report
H. D. Orville, W. R. Cotton, L. G. Davis, D. B. Johnson, and R. M. Rauber Sep. 1986 47 p
(Contract NA83RA-C-00088)
(PB87-152229) Avail: NTIS HC A03/MF A01 CSCL 04B

The committee was reconstituted in December, 1983, to review the on-going state operational programs in North Dakota and in Utah and to make initial studies of the Nevada and Illinois programs. The committee met for two days (December 19-20) in Bismarck, ND, to review the state operational program concerning the seeding of summer convective clouds. In the first week of January, the committee met with Utah personnel in Salt Lake City to be briefed on their winter cloud seeding program. Later that week the committee personnel traveled to Reno, Nevada, to review the Desert Research Institute's (DRI's) winter orographic cloud seeding program being carried out in cooperation with the Bureau of Reclamation's Sierra Cooperative Pilot Project. The purpose of the visit to DRI was to learn about the Nevada state program and to discuss hypotheses involved in the program. GRA

N87-22378# Oak Ridge National Lab., Tenn.
CLIMATE PREDICTIONS, REGIONS, AND RESOURCES
R. M. Cushman, J. C. Waterhouse, and M. P. Farrell 1986 14 p Presented at the 5th US-USSR Symposium on Comprehensive Analysis of the Environment, Washington, D.C., 10 Dec. 1986
(Contract DE-AC05-84OR-21400)
(DE87-006625; CONF-861269-1) Avail: NTIS HC A02/MF A01

The paper discusses the development of methods to refine the predictions of climate change on a regional scale. Emphasis is placed on the development and refinement of analytical methods for multiresource, regional effects analyses. Some questions considered are: What types of regions (possibly, combinations thereof) are optimal for the analyses. What resources are of greatest importance. What cause-and-effect models are most suitable - regression, simulation. What resource interactions and feedbacks need to be considered. How should resource data be managed and aggregated to regional levels. DOE

N87-22379# National Severe Storms Lab., Norman, Okla.
LOW ALTITUDE WIND SHEAR DETECTION WITH DOPPLER RADAR Final Report
Michael D. Eilts Feb. 1987 40 p
(Contract DTFA01-80-Y-10524)
(DOT/FAA/PM-87/6) Avail: NTIS HC A03/MF A01

The feasibility of using the next generation weather radar (NEXRAD) system to detect low-altitude horizontal wind shear near airports is investigated. The surface-measured horizontal shear is compared with that observed aloft with Doppler radar to determine how the radar-estimated shear above the surface relates to the surface-measured shear. For five Oklahoma gust fronts, the Doppler radar estimate of shear averaged 1.6 times the shear measured at the surface. For none of 43 comparisons was the surface radial velocity difference across the gust front stronger than the radial velocity difference measured by the Doppler radar aloft. When the five gust fronts passed an instrumented tower a vertical profile through the lowest 440 m of the gust front could be determined. In all cases the peak wind shear was at a much higher altitude. Due to surface friction it is expected that wind speeds and shears in downbursts will also be stronger aloft than at the surface, however, further study is necessary. It is suggested that a combination of Doppler radar data and information gleaned from a Low-Level Wind Shear Alert System would allow more accurate wind shear estimates in the terminal area or airports than would be possible with either system by itself. Author

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N87-22380# Miami Univ., Fla. Div. of Meteorology and Physical Oceanography.

CIRCULATION AND EXCHANGE PROCESSES ON THE SOUTH ATLANTIC BIGHT Progress Report, 1 Jun. 1986 - 31 May 1987

T. N. Lee Jan. 1987 48 p

(Contract DE-FG05-85ER-60355)

(DE87-005307; DOE/ER-60355/1) Avail: NTIS HC A03/MF A01

A Spring Removal EXperiment (SPREX) was devised to investigate the processes involved in the transport of fresh water from the inner-shelf in the vicinity of Savannah, Ga. where river discharge is greatest, to the outer shelf south of Cape Fear, S.C., where rapid exchange with the offshore current can occur. The SPREX experiment was conducted in the spring of 1985; however, prior to this we conducted a pilot experiment called pre-SPREX during the spring of 1984. The studies took place in the spring in order to investigate the processes associated with the offshore transport of low salinity nearshore waters to the oceanic sink that is believed to occur during this season. Available evidence indicates that this spring removal process occurs as an episodic response to: (1) accumulation of river run-off in the Coastal Boundary zone, (2) northeastward wind events, and (3) seasonal development of shelf stratification. During the period from June 1, 1986 to May 31, 1987, efforts were concentrated on: (1) publication of scientific results from the GABEX studies; (2) processing and analysis of the pre-SPREX and SPREX data sets; (3) cooperative studies with other DOE/SAB investigators; and (4) planning for the Fall Transport Experiment (FLEX). DOE

N87-22381# SACLANT ASW Research Center, San Bartolomeo (Italy). Spezia (italy).

SELECTED PAPERS ON OCEAN-SEISMO ACOUSTICS LOW-FREQUENCY UNDERWATER ACOUSTICS BASED ON THE SACLANTCEN CONTRIBUTIONS TO A SYMPOSIUM HELD BY SACLANTCEN ON 10-14 JUNE 1985

Tuncay Akal, comp. and Johathan M. Berkson, comp. Jun. 1986 109 p Symposium held in Italy, 10-14 Jun. 1985

(AD-A177308; SACLANTCEN-CP-37) Avail: NTIS HC A06/MF A01 CSCL 08J

The following reports were presented at the SANCLANTCEN conference on underwater acoustics: Time dependence of infrasonic ambient seafloor noise on a continental shelf; The use of Love waves to determine the geoacoustic properties of marine sediments; Medium induced low frequency fluctuations in acoustic transmission loss; Directional measurements of low frequency acoustic backscattering from the seafloor; Shear properties of ocean sediments determined from numerical modelling of Scholte wave data; Evaluation of low frequency bottom backscattering strength vs grazing angle by means of multiple beamforming; Spatial variability of surficial shallow water sediment geoacoustic properties; Evaluation of experimental techniques for determining the plane wave reflection coefficient at the sea floor; Interface wave studies on the Ligurian shelf using an OBS array; experimental results and propagation models; and Low frequency anomalies in the reflection behavior of marine sediments. GRA

N87-22382# Coastal Engineering Research Center, Vicksburg, Miss.

DUCK '85 NEARSHORE WAVES AND CURRENTS EXPERIMENT DATA SUMMARY REPORT Final Report

Jon M. Hubertz, Charles E. Long, Panola Rivers, and Willie A. Brown Feb. 1987 210 p

(AD-A177419; CERC-MP-87-3) Avail: NTIS HC A10/MF A01 CSCL 08C

This report provides a summary of mean values of data collected during the nearshore waves and currents experiment which was part of the DUCK '85 field program. The objectives of the experiment was to collect data which could be used to study coastal processes and verify numerical models. Data sets such as this provide valuable prototype measurements for validation of theories and techniques which can be used to predict nearshore waves and currents for various climatic conditions. GRA

N87-22383# Office of Naval Research, London (England).

CONFERENCE (1986) ON THE VARIABILITY OF THE ATMOSPHERE AND OCEANS

Jerome Williams 30 Jan. 1987 13 p Conference held in London, England, 8-12 Sep. 1986

(AD-A177535; ONRL-7-004-C) Avail: NTIS HC A02/MF A01 CSCL 08J

The thrust of this meeting belongs to the modelers and models, and the greatest emphasis concerned the tropical regions--the E1 Nino event being the focus of most interest. The modeling effort appears to be progressing at a reasonable rate but is hampered by lack of accurate data sets. Of the 70 papers presented, 37 were by Americans, and it is concluded that American modelers are still leading the world effort. GRA

N87-22384# Woods Hole Oceanographic Institution, Mass.

FASINEX (FRONTAL AIR-SEA INTERACTION EXPERIMENT. JANUARY - JUNE 1986). CRUISE SUMMARIES FOR FASINEX PHASE 2: R/V OCEANUS CRUISE 175 R/V ENDEAVOR CRUISE 141

Nancy J. Pennington and Robert A. Weller Oct. 1986 164 p

(Contract N00014-84-C-0134)

(AD-A177776; WHOI-86-36; TR-14) Avail: NTIS HC A08/MF A01 CSCL 08C

The Frontal Air-Sea Interaction Experiment (FASINEX) was a study of the response of the upper ocean to atmospheric forcing in the vicinity of an oceanic front in the subtropical convergence zone southwest of Bermuda, the response of the lower atmosphere in that vicinity to the oceanic front, and the associated two-way interaction between ocean and atmosphere. FASINEX began in the winter (January 1986), concluded in the early summer (June 1986) and included an intensive period in February and March. The experiment took place in the vicinity of 27 deg N, 70 deg W where sea-surface-temperature fronts are climatologically common. Measurements were made from buoys, ships, aircraft and spacecraft. This report summaries the shipboard work done on R/V OCEANUS and R/V ENDEAVOR during Phase Two, the dual ship/multi-aircraft measurement period. The two ships worked individually, jointly and as ground truth for the aircraft during the month. Each ship carried specialized instrumentation for measuring oceanographic and meteorological parameters. Information describing the sampling strategy, station positions, and times are included. This report contains summaries of the data collected and some preliminary results. Author (GRA)

N87-22385# Woods Hole Oceanographic Institution, Mass.

FASINEX (FRONTAL AIR-SEA INTERACTION EXPERIMENT), JANUARY-JUNE 1986. SUMMARIES FOR FASINEX MOORING CRUISES. PHASE 1: R/V KNORR 119. PHASE 3: R/V KNORR CRUISE 123

Nancy J. Pennington and Robert A. Weller Oct. 1986 235 p

(Contract N00014-84-C-0134)

(AD-A177835; WHOI-86-35; FASINEX-TR-13) Avail: NTIS HC A11/MF A01 CSCL 08J

FASINEX was a study of the response of the upper ocean to atmospheric forcing in the vicinity of an oceanic front in the subtropical convergence zone southwest of Bermuda. The response of the lower atmosphere in that vicinity to the oceanic front, and the associated two-way interaction between ocean and atmosphere were studied. FASINEX began in January 1986, concluded in June 1986 and included an intensive period in February and March. The experiment took place in the vicinity of 27 deg N, 70 deg W where sea-surface-temperature fronts are climatologically common. Measurements were made from ships, aircraft etc. This report summarizes the mooring deployment and recovery cruises. FASINEX Phase One, the development cruise,

located a frontal feature, mapped it and set an array of surface and profiling current meter moorings across the front. The recovery cruise returned to the FASINEX area to retrieve the instrumentation that had been on station for six months. Additional measurements were made in the frontal region during these cruises. The activities carried out and the underway data collected on these two cruises, details of the moored array and a preliminary statement of the data return from the array, and the data telemetered from the moored array via ARGOS are summarized. GRA

N87-22386*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 1982-1983 EL NINO ATLAS: NIMBUS-7 MICROWAVE RADIOMETER DATA
W. Timothy Liu 15 Feb. 1987 77 p Sponsored by NASA
(NASA-CR-180914; JPL-Pub-87-5; NAS 1.26:180914) Avail: NTIS HC A05/MF A01 CSCL 08C

Monthly maps of sea surface temperature, atmospheric water vapor, and surface level wind speed as measured by the Scanning Multichannel Microwave Radiometer (SMMR) on the Nimbus-7 satellite for the tropical Pacific from June 1982 to October 1983, during one of the most intense El Nino Southern Oscillations (ENSO) episodes, are presented. The non-ENSO annual cycle was compiled by averaging the 1980 and 1981 data for each calendar month and was removed from monthly fields of 1982 and 1983 to reveal the anomalous distributions. The anomaly fields and part of the non-ENSO annual cycle are also presented. This study and earlier evaluations demonstrate that the Nimbus/SMMR can be used to monitor large scale and low frequency variabilities in the tropical ocean. The SMMR data support and extend conventional measurements. The variabilities of the three parameters are found to represent various aspects of ENSO related through ocean atmosphere interaction. Their simultaneous and quantitative descriptions pave the way for the derivation of ocean atmosphere latent heat exchange and further the understanding of the coupled atmospheric and oceanic thermodynamics.
Author

N87-22387# Alaska Univ., Fairbanks. Geophysical Inst.
STATISTICAL DESCRIPTION OF THE SUMMERTIME ICE EDGE IN THE CHUKCHI SEA, TASK 2 Final Report
W. J. Stringer and J. E. Groves Jan. 1987 217 p
(Contract DE-AC21-83MC-20037)
(DE87-001056; DOE/MC-20037/2265) Avail: NTIS HC A10/MF A01

Ice edge data has been analyzed for ice recursion analysis in the Chukchi Sea for a twelve year period. Conclusions drawn include: (1) numerous parameter comparisons describing the great variability of ice extent found in the Chukchi Sea; (2) that for a period of 80 to 100 days beginning with August and continuing through October, ice-free water will exist in the Chukchi Sea south of 70 deg N and 175 deg W. Within these boundaries ice will return (recur) once after it has retreated in the spring, or it will retreat once after it has returned in the fall, less than 50% of the time; (3) ice in the western Chukchi Sea (along the Siberian coast) may provide multi-year ice to the Bering Sea through Bering Strait starting in late fall; (4) melt-back bays (defined by Paquette and Bourke, 1981) created by warm Bering Sea waters channeled by Chukchi Sea bathymetry are persistent and significant features of the Chukchi Sea ice edge. DOE

N87-22388# National Oceanic and Atmospheric Administration, Washington, D. C.
THE AVHRR/HIRS OPERATIONAL METHOD FOR SATELLITE BASED SEA SURFACE TEMPERATURE DETERMINATION
Charles Walton Mar. 1987 65 p
(NOAA-TR-NESDIS-28) Avail: NTIS HC A04/MF A01

A technique which was used operationally to produce sea surface temperatures from the NOAA polar orbiting satellites between 1976 and 1981 is described. The single window channel technique used before 1976 is described in the NOAA Technical Memorandum NESS 78 while the multiple window channel technique (MCSST) applied since 1981 is well documented. This information bridges the gap between these two periods and provides a continuous record of the evolution of one of NOAA's primary satellite derived meteorological products. Author

N87-21980# Joint Publications Research Service, Arlington, Va.
POSSIBILITIES OF USING ARTIFICIAL EARTH SATELLITE DATA FOR COMPUTING HEAT EXCHANGE BETWEEN THE OCEAN AND ATMOSPHERE IN NEWFOUNDLAND ENERGY-ACTIVE ZONE DURING WINTER
D. G. Rzheplinskiy and N. N. Shvyrkov *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 180-181 Transl. into ENGLISH from Issledovaniye Zemli iz Kosmosa (Moscow, USSR), no. 4, Jul. - Aug. 1986 p 32-41 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

51 LIFE SCIENCES (GENERAL)

N87-22389*# Research Triangle Inst., Research Triangle Park, N.C.
APPLICATIONS OF AEROSPACE TECHNOLOGY Final Report, 23 Nov. 1982 - 31 Dec. 1983
Doris J. Rouse May 1984 73 p
(Contract NAS1-17214)
(NASA-CR-172346; NAS 1.26:172346) Avail: NTIS HC A04/MF A01 CSCL 06B

The objective of the Research Triangle Institute Technology Transfer Team is to assist NASA in achieving widespread utilization of aerospace technology in terrestrial applications. Widespread utilization implies that the application of NASA technology is to benefit a significant sector of the economy and population of the Nation. This objective is best attained by stimulating the introduction of new or improved commercially available devices incorporating aerospace technology. A methodology is presented for the team's activities as an active transfer agent linking NASA Field Centers, industry associations, user groups, and the medical community. This methodology is designed to: (1) identify priority technology requirements in industry and medicine, (2) identify applicable NASA technology that represents an opportunity for a successful solution and commercial product, (3) obtain the early participation of industry in the transfer process, and (4) successfully develop a new product based on NASA technology. Author

N87-22390*# Management and Technical Services Co., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 11
Lydia Razran Hooke, ed., Victoria Garshnek, ed., Mike Radtke, ed., Ronald Teeter, ed., and Joseph Rowe, ed. (Library of Congress, Washington, D. C.) Washington NASA May 1987 126 p
(Contract NASw-3676)
(NASA-CR-3922(13); NAS 1.26:3922(13)) Avail: NTIS HC A07/MF A01 CSCL 06B

This is the eleventh issue of NASA's USSR Space Life Sciences Digest. It contains abstracts of 54 papers recently published in Russian language periodicals and bound collections and of four new Soviet monographs. Selected abstracts are illustrated. Additional features include the translation of a paper presented in Russian to the United Nations, a review of a book on space ecology, and report of a conference on evaluating human functional capacities and predicting health. Current Soviet Life Sciences titles available in English are cited. The materials included in this issue have been identified as relevant to 30 areas of aerospace medicine and space biology. These areas are: adaptation, aviation physiology, biological rhythms, biospherics, body fluids, botany, cardiovascular and respiratory systems, cosmonaut training, developmental biology, endocrinology, enzymology, equipment and instrumentation, gastrointestinal systems, group dynamics, genetics, hematology, human performance, immunology, life support systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition,

operational medicine, perception, personnel selection, psychology, and radiobiology. Author

N87-22391*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LIFE SCIENCES LABORATORY EQUIPMENT CATALOG
Jun. 1987 34 p
(NASA-TM-89289; NAS 1.15:89289) Avail: NTIS HC A03/MF A01 CSCL 06B

A composite inventory of equipment available from the Ames Research Center for microgravity experiments using the Shuttle Transportation System (STS) Middeck and Spacelab is provided. B.G.

N87-22113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANIMAL STUDIES ON SPACELAB-3
C. Schatte, R. Grindeland, P. Callahan, W. Berry, G. Funk, and W. Lencki (Management and Technical Services Co., Philadelphia, Pa.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 75-83 Previously announced as N86-16889 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 06C

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N87-22392# Illinois Univ., Chicago. Coll. of Medicine.
ROLE OF ADENOSINE ANALOGS AND GROWTH HORMONE IN WAKING AND SLEEP Annual Report, 15 Sep. 1985 - 15 Sep. 1986
Miodrag Radulovacki 2 Feb. 1987 4 p
(Grant AF-AFOSR-0349-85)
(AD-A177385; AFOSR-87-0078TR) Avail: NTIS HC A02/MF A01 CSCL 06A

The mechanism of hypnotic action of adenosine was investigated. Rats deprived of rapid-eye-movement sleep (REMS) show an increase in adenosine receptors in two brain regions, the cerebral cortex and the corpus striatum. At the same time there is no change in brain adenosine concentration. Chronic administration of diazepam stimulated adenosine receptors and decreased the number of A1 receptors in hippocamupus and A2 receptors in the striatum. GRA

N87-22393# Army Research Inst. of Environmental Medicine, Natick, Mass.
OPERATION EVEREST 2: LACK OF AN EFFECT OF EXTREME ALTITUDE ON VISUAL CONTRAST SENSITIVITY
John L. Kobrick, Edith Crohn, Barbara Shukitt, and Charles S. Houston Jan. 1987 26 p
(AD-A177577) Avail: NTIS HC A03/MF A01 CSCL 06S

Contrast sensitivity thresholds were studied during gradual ascent over 40 days to a simulated altitude of 25,000 feet in a decompression chamber. Only ambient pressure, and thus inspired oxygen pressure was varied, thereby eliminating many of the confounding effects of cold, dehydration, malnutrition and exhaustion, inevitably encountered on very high mountains. Contrast sensitivity thresholds measured by the Ginsburgh Vistech test showed no overall impairment as altitude increased. These results are in contrast to findings of other previously reported vision studies involving shorter exposures and lower altitudes than those of the present study. However, our findings can be reconciled with previous contrary results on the basis of the higher stimulus luminances used in our contrast sensitivity testing. Compared to the luminance levels involved in previously reported night vision testing, our stronger stimuli would be less likely to be affected by hypoxia. GRA

N87-22394# Army Research Inst. of Environmental Medicine, Natick, Mass.
EFFECTS OF VARIOUS ENVIRONMENTAL STRESSORS ON COGNITIVE PERFORMANCE
L. E. Banderet, B. L. Shukitt, E. A. Crohn, R. L. Burse, and D. E. Roberts 27 Jan. 1987 6 p
(AD-A177587) Avail: NTIS HC A02/MF A01 CSCL 06N

Rigorous testing instruments and psychometric methods are required to assess the effects of enviromental stressors upon cognitive performance. This paper presents findings and illustrates our methodology for evaluating the effects of several types of environmental stressors. Various cognitive performances were investigated experimentally with paper and pencil tasks in repeated-measures paradigms for several high altitudes, altitude-treatment strategy, dehydration cold, atropine in a hot environment. Cognitive performances was to decreases in the rate of performance rather than increased errors, e.g., problem solving rates decreased linearly from 4500 to 7600 m (15,000 to 25,000) high altitude during a 40-day progressive exposure. Recovery of performance during 2 days at 4600 m depended upon the task; not all tasks improved fully. A treatment strategy (tyrosine) minimized altitude-induced performance impairments on some tasks. Our results suggest even well-practiced and overlearned tasks deteriorate with environmental stressors. Adequate stressor levels, enough subjects practiced tasks with demonstrated stability and sensitivity, appropriate time sampling, and the recruitment of maximum performance before experimentation are critical factors for our approach. GRA

N87-22395# Army Research Inst. of Environmental Medicine, Natick, Mass.
A SYSTEM FOR CONTROLLED PRESENTATION OF THE ARDEN CONTRAST SENSITIVITY TEST
John L. Kobrick, Harry I. Zeltzer, and Stephen Mullen 3 Dec. 1986 16 p
(AD-A177640; USARIEM-M-15/87) Avail: NTIS HC A02/MF A01 CSCL 20F

The visual detection of differences in brightness, also called contrast sensitivity, is increasingly recognized in recent years as a phenomenon of potentially great significance both for explaining the visual perception process and for diagnosing visual disorders. The contrast sensitivity function (CSF) is generally recognized as a useful index of the process, and is considered to be based mainly on detection of spatial frequencies contained in the luminance contrast patterns of visual stimuli striking the retina. The Arden test of contrast sensitivity was recognized as a simple and easily administered technique for measurement of this process. However, the customary method of administration of this test involves manual manipulation and considerable individual subjectivity. The instrument described in this report was designed and developed to minimize variability in the testing procedure due to differences in individual testing techniques, and to standardize testing conditions, ambient illumination, viewing distance and rates of presentation. The CSF can provide information about the status of the human visual system which cannot be obtained from visual acuity measurements. GRA

N87-22396# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MOTION SICKNESS PREDICTION MODEL AND SYSTEM DESCRIPTION M.S. Thesis
Dana R. Hartle Dec. 1986 201 p
(AD-A177716; AFIT/GCS/ENG/86D-3) Avail: NTIS HC A10/MF A01 CSCL 06R

The existing biophysical data acquisition system was modified and refined to improve data collection and analysis. Several of the parameter sensors were redesigned and several new sensors were added. Several of the previously used sensors such as thoracic and diaphragmatic respiration, temperature, and pallor were calibrated to provide a quantifiable range of data. The calibrated values can now be equated to recognizable values, such as volume (CC) for thoracic and diaphragmatic respiration, degrees fahrenheit for temperature, and the percentage of minimum

to maximum blood flow for pallor. The electrical schematics of the sensors were updated to match the existing equipment. The collected data parameters were analyzed spectrally and statistically to produce a motion sickness prediction model. The data results for each parameter are discussed in depth with the onset of motion sickness. GRA

N87-22397# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
MOTION SICKNESS: A STUDY OF ITS ETIOLOGY AND A STATISTICAL ANALYSIS M.S. Thesis
Robert D. Miller Dec. 1986 154 p
(AD-A177786; AFIT/GCS/ENG/86D-2) Avail: NTIS HC A08/MF A01 CSCL 06S

The affects of motion induced sickness on the human physiology are investigated. Physiologic data were collected from 12 test volunteers who were spun in a multiaxis rotating chair to elicit a motion sickness response. The data collected were statistically analyzed using linear regression techniques to develop a model that can be used to predict the onset of motion sickness. Evidence indicates that many of the classical physiologic parameters studied are strongly correlated to each other and as a result, must be studied together in order to effectively piece together the complex interrelationships of motion sickness. Major recommendations for future AFIT research include analyzing the data through the use of other multivariant techniques, including nonlinear regression, as well as testing the model developed during this research against actual experimental data. Another recommendation includes integrating a computer, either a mainframe or a personal computer, along with an analog to digital conversion board and associated software and data acquisition and data analysis software to the current system to enhance collection and analysis capabilities. GRA

N87-22398# California Univ., Berkeley. Lawrence Berkeley Lab.
INTERACTION MECHANISMS, BIOLOGICAL EFFECTS AND BIOMEDICAL APPLICATIONS OF STATIC AND EXTREMELY-LOW-FREQUENCY MAGNETIC FIELDS
T. S. Tenforde Apr. 1986 60 p Presented at the 22nd Annual Meeting of the National Council on Radiation Protection and Measurements, Washington, D.C., 2 Apr. 1986
(Contract DE-AC03-76SF-00098)
(DE87-006946; LBL-22321; CONF-860451-2) Avail: NTIS HC A04/MF A01

A major stimulus for research on the bioeffects of static magnetic fields has been the effort to develop technologies for energy production and storage that utilize intense magnetic fields. In addition, the rapid emergence of magnetic resonance imaging as a new clinical diagnostic procedure has provided a strong rationale for defining the possible biological effects of magnetic fields with high intensities. The numerous sources of time-varying magnetic fields with frequencies in the extremely-low-frequency (ELF) range has also led to an increased emphasis on defining the interactions of these fields with biosystems. Of particular interest has been the potential biological effects of fields with 50 and 60 Hz frequencies. However, fields with other frequencies in the ELF range are also of interest because of their use in communication systems and in certain medical procedures. In this report the principal interaction mechanisms of static and time-varying magnetic fields are described, and a summary is provided of the current state of knowledge on the biological effects of these fields based on laboratory studies. The final section describes several useful applications of magnetic fields in medicine and biological research. DOE

N87-22399*# Stanford Univ., Calif. Dept. of Psychology.
COMPUTATIONAL MODELS OF HUMAN VISION WITH APPLICATIONS Final Report, 1 Nov. 1984 - 31 Oct. 1986
Brian A. Wandell [1987] 4 p
(Contract NCC2-332)
(NASA-CR-180924; NAS 1.26:180924) Avail: NTIS HC A02/MF A01 CSCL 06P

The research program supported by this grant was initiated in 1977 by the Joint Institute for Aeronautics and Acoustics of the Department of Aeronautics and Astronautics at Stanford University. The purpose of the research was to study human performance with the goal of improving the design of flight instrumentation. By mutual agreement between the scientists at NASA-Ames and Stanford, all research activities in this area were consolidated into a single funding mechanism, NCC 2-307 (Center of Excellence Grant, 7/1/84 - present). This is the final report on this research grant. Author

N87-21977# Joint Publications Research Service, Arlington, Va.
YEAR-LONG HYPOKINESIA EXPERIMENT IN PROGRESS: DAILY LIFE OF PARTICIPANTS DESCRIBED
L. Repin *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 121-126 Transl. into ENGLISH from Kosmolskaya Pravda (Moscow, USSR), 10 Aug. 1986 p 4 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N87-22400# Northwestern Univ., Evanston, Ill. Neuroscience Lab.
PERCEPTION OF MOTION IN STATISTICALLY-DEFINED DISPLAYS (ENHANCING SENSITIVITY TO VISUAL MOTION) Final Report, 1 Oct. 1980 - 30 Sep. 1985
Robert Sekuler 5 Jan. 1987 100 p
(Grant AF-AFOSR-0246-80)
(AD-A177310; AFOSR-87-0045TR) Avail: NTIS HC A05/MF A01 CSCL 05E

The grant supported three complementary major studies of motion perception, each designed to educiate a different aspect of the mechanisms that underline such perception. Project One: Directional-specific improvement in motion discrimination (Karlene Ball and Robert Sekuler). Project Two: Coherent global motion from stochastic local motions (Douglas Williams and Tobert Sekuler). Project Three: Exploring motion perception by means of psychophysical matches between physically different stimuli (metamers) (Douglas Williams, Scott Tweeten, Robert Sekuler). GRA

N87-22401# Army Research Inst. of Environmental Medicine, Natick, Mass.
DEVELOPMENT OF COGNITIVE TESTS FOR REPEATED PERFORMANCE ASSESSMENT
L. E. Banderet, K. P. Benson, and D. M. MacDougall Jun. 1986 24 p
(AD-A177591; USARIEM-T-17/86) Avail: NTIS HC A02/MF A01 CSCL 05J

Two cognitive performance tests, Computer Interaction (CI) and Tower of Hanoi (HT), were generated as paper and pencil tests with alternate forms. The CI Test evaluates a person's transactions with a computer system (Radio Shack desk-top calculator EC-2004). The HT Test, a popular puzzle and test of logical reasoning, was adapted for discrete, forced-choice responses. In testing situations subjects are instructed and practiced extensively before independent variables are manipulated. Both tests are always timed. Our studies indicate these tests have high task definitions and stabilities. Repeated assessment produced stability (reliability) coefficients of greater than 0.70 and 0.80 for CI and HT, respectively. Stability was achieved on CI and HT (decision of POSSIBLE after 30 to 60 min of practice, i.e., 5 to 10 administrations. The decision of OPTIMAL on Ht required 60 to 90 min (10 to 15 administrations). The HT Test was also programmed on a briefcase computer (NEC PC-8201A) but this version has not been evaluated systematically.

These methods produce tests with functional properties that may be useful to military or civilian psychometricians. GRA

N87-22402# Technische Univ., Berlin (West Germany). Fachbereich Verkehrswesen.
REPORT ON THE WORKING ORGANIZATION AND DEVELOPMENT OF A FLIGHT CREW IN CIVIL AIRCRAFT Ph.D. Thesis [BEITRAG ZUR BEURTEILUNG DER ARBEITSORGANISATION BEI DER ARBEITSPROZESS - ENTWICKLUNG FUER DIE COCKPIT-BESATZUNG ZIVILER TRANSPORT FLUGZEUGE]
Christian Vees 1984 168 p In GERMAN; In GERMAN
(ETN-87-99341) Avail: NTIS HC A08/MF A01

A simulation (Monte Carlo method) of intra-cockpit communication, based on the queueing model and referring to the pilot's decision making in a multitask situation is presented. The application of the model is shown on a two-man crew, but its functional mechanisms are insufficient. Solutions are discussed and ways of evaluation and instruction in civil pilot training are proposed. ESA

N87-22112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AUTOGENIC-FEEDBACK TRAINING: A PREVENTIVE METHOD FOR SPACE ADAPTATION SYNDROME
Patricia S. Cowings, Joseph C. Sharp, William B. Toscano, Joe Kamiya, and Neal E. Miller (Yale Univ., New Haven, Conn.) *In* NASA. Marshall Space Flight Center Spacelab 3 Mission Science Review Feb. 1987 p 84-90 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 05I

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N87-22403*# Wisconsin Univ., Madison. Dept. of Horticulture.
CONTROLLED ENVIRONMENT LIFE SUPPORT SYSTEM: CALCIUM-RELATED LEAF INJURIES ON PLANTS
T. W. Tibbitts Mar. 1986 38 p
(Contract NCC2-136)
(NASA-CR-177399; NAS 1.26:177399; T-5295) Avail: NTIS HC A03/MF A01 CSCL 05H

Calcium related injuries to plants grown in controlled environments under conditions which maximize plant growth rates are described. Procedures to encourage movement of calcium into developing leaves of lettuce plants were investigated. The time course and pattern of calcium accumulation was determined to develop effective control procedures for this injury, termed tipburn. Procedures investigated were: (1) increasing the relative humidity to saturation during the dark period and altering root temperatures, (2) maximizing water stress during light and minimizing water stress during dark periods, (3) shortening the light-dark cycle lengths in combination with elevated moisture levels during the dark cycles, (4) reducing nutrient concentrations and (5) vibrating the plants. Saturated humidities at night increased the rate of growth and the large fluctuation in plant water potential encouraged calcium movement to the young leaves and delayed tipburn. Root temperature regulation between 15 and 26 C was not effective in preventing tipburn. Attempts to modulate water stress produced little variation, but no difference in tipburn development. Variations in light-dark cycle lengths also had no effect on calcium concentrations within developing leaves and no variation in tipburn development. Low concentrations of nutrient solution delayed tipburn, presumably because of greater calcium transport in the low concentration plants. Shaking of the plants did not prevent tipburn, but did delay it slightly. Author

N87-22404*# San Francisco Univ., Calif. Coll. of Professional Studies.
ATMOSPHERE STABILIZATION AND ELEMENT RECYCLE IN AN EXPERIMENTAL MOUSE-ALGAL SYSTEM
David T. Smernoff Mar. 1986 96 p
(Contract NCC2-210)
(NASA-CR-177402; NAS 1.26:177402; T-6632) Avail: NTIS HC A05/MF A01 CSCL 05H

Life support systems based on bioregeneration rely on the control and manipulation of organisms. Experiments conducted with a gas-closed mouse-algal system designed to investigate principles of photosynthetic gas exchange focus primarily on observing gas exchange phenomena under varying algal environmental conditions and secondarily on studying element cycling through compartments of the experimental system. Inherent instabilities exit between the uptake and release of carbon dioxide CO2 and oxygen O2 by the mouse and algae. Variations in light intensity and cell density alter the photosynthetic rate of the algae and enable maintenance of physiologic concentrations of CO2 and O2. Different nitrogen sources (urea and nitrate) result in different algal assimilatory quotients (AQ). Combinations of photosynthetic rate and AQ ratio manipulations have been examined for their potential in stabilizing atmospheric gas concentrations in the gas-closed algal-mouse system. Elemental mass balances through the experimental systems compartments are being studied with the concurrent development of a mathematical simulation model. Element cycling experiments include quantification of elemental flows through system compartments and wet oxidation of system waste materials for use as an algal nutrient source. Oxidized waste products demonstrate inhibitory properties although dilution has been shown to allow normal growth. Author

N87-22405*# California Univ., Berkeley. Dept. of Mechanical Engineering.
NONLINEAR SYSTEM CONTROLLER DESIGN BASED ON DOMAIN OF ATTACTION: AN APPLICATION TO CELSS ANALYSIS AND CONTROL
P. S. Babcock, IV Mar. 1986 121 p
(Contract NCC2-67)
(NASA-CR-177401; NAS 1.26:177401; T-4081) Avail: NTIS HC A06/MF A01 CSCL 12B

Nonlinear system controller design based on the domain of attraction is presented. This is particularly suited to investigating Closed Ecological Life Support Systems (CELSS) models. In particular, the dynamic consequences of changes in the waste storage capacity and system mass, and how information is used for control in CELSS models are examined. The models' high dimensionality and nonlinear state equations make them difficult to analyze by any other technique. The domain of attraction is the region in initial conditions that tend toward an attractor and it is delineated by randomly selecting initial conditions from the region of state space being investigated. Error analysis is done by repeating the domain simulations with independent samples. A refinement of this region is the domain of performance which is the region of initial conditions meeting a performance criteria. In nonlinear systems, local stability does not insure stability over a larger region. The domain of attraction marks out this stability region; hence, it can be considered a measure of a nonlinear system's ability to recovery from state perturbations. Considering random perturbations, the minimum radius of the domain is a measure of the magnitude of perturbations for which recovery is guaranteed. Design of both linear and nonlinear controllers are shown. Three CELSS models, with 9 to 30 state variable, are presented. Measures of the domain of attraction are used to show the global behavior of these models under a variety of design and controller scenarios. Author

N87-22406 Ohio State Univ., Columbus.
KINEMATIC AND PASSIVE RESISTIVE PROPERTIES OF HUMAN SHOULDER, HIP AND ELBOW COMPLEXES Ph.D. Thesis
Shuenn-Muh Chen 1986 210 p
Avail: Univ. Microfilms Order No. DA8625193

Shuenn-Muh Chen 1986 210 p
Avail: Univ. Microfilms Order No. DA8625193

In the last two decades, the computer-based multisegmented models of the total human body have gained increasing attention in their applications to simulate car crash victims and aerospace related applications. A computer-aided data acquisition system is described which was designed and developed to collect the three-dimensional kinematic data for the maximum voluntary ranges of motion and force data for the passive resistive properties beyond the voluntary ranges for the human shoulder, hip, and elbow complexes. A sonic digitizing technique using an overdeterminate number of sonic emitters is employed to continuously collect and check the accuracies of the kinematic data. A three-dimensional multiple-axis force and moment transducer is utilized to collect the resistive properties data. All data are expressed in functional expansion form for easy incorporation into the existing three-dimensional multisegmented models of the total human body. Finally, statistical data bases for the shoulder, hip, and elbow complexes are established based on a random sample of ten normal male subjects whose ages range from 18 thru 32. Estimates for the population mean and standard deviation as well as their confidence intervals are presented. The ultimate overall performance of the data acquisition system and efficacy of the associated data analysis technique are manifested by the good repeatability of sample means and sample standard deviations from different kinematic test runs made on the same sample.
Dissert. Abstr.

N87-22407# California Univ., Santa Barbara. Community and Organization Research Inst.
HAPTIC EXPLORATION IN HUMANS AND MACHINES: AN INITIAL OVERVIEW Technical Report, 1 May 1986 - 30 Apr. 1987
Susan J. Lederman, Roberta L. Klatzky, and R. Bajcsy 28 Jan. 1987 55 p Sponsored by ONR
(AD-A177315; TR-87-01) Avail: NTIS HC A04/MF A01 CSCL 05J

This technical report comprises two publications. The first provides an overview of our research program in haptic object processing. The second indicates in detail how the analysis of human exploratory procedures may be applied to the control of one- and two-fingered robot hands. GRA

N87-22408# Signal Research Center, Inc., Des Plaines, Ill.
DEVELOPMENT AND CHARACTERIZATION OF OXIDATION CATALYSTS FOR AIR PURIFICATION Contractor Report, Aug. 1984 - Sep. 1985
George R. Lester and Richard E. Marinangeli Feb. 1987 27 p
(Contract DAAK11-84-C-0053)
(AD-A177375; CRDEC-CR-87050) Avail: NTIS HC A03/MF A01 CSCL 06T

The objective of this project was the development and characterization of low temperature catalysts for removal of toxic chemical agents from air. Collective protection systems are being developed which depend on the catalytic destruction of chemical and biological agents. This method of air purification offers several potential advantages over conventional absorption systems, but successful development will require highly active catalysts which can function at temperatures as low as 250 C in order to minimize weight, volume and energy requirements. The objective of this research has been the identification of such catalysts by the determination of the important catalyst characteristics which affect the rate of destruction of a wide range of chemical agents and agent simulants, including cyanogen chloride (CK), hydrogen cyanide (AC), phosgene (CG), and dimethyl methylphosphonate (DMMP), by catalytic oxidation and/or hydrolysis. Catalytic destruction of CG was achieved at temperatures as low as 75 C and of CK as low as 150 C. The best catalysts identified for conversion of AC and DMMP showed high initial activity at 250 C.
GRA

N87-22409# BioTechnology, Inc., Falls Church, Va.
LIFE SUPPORT AND PROTECTION REQUIREMENTS FOR THE HEAD/NECK REGION OF NAVY AIRCREWMEN Final Report
James F. Parker, Jr., Diane G. Christensen, and George R. Mutimer Dec. 1986 88 p
(Contract N00014-77-C-0253)
(AD-A177469) Avail: NTIS HC A05/MF A01 CSCL 06G

A Navy aircrewman is protected through use of an Aviation Life Support System (ALSS), the basic form of which has changed little through the years. This project examined primary life support and protection needs as a first step toward the development of an advanced ALSS to match the missions and flight regimes of future. Information covering: (1) reports of emergency escape from Navy aircraft under the combat conditions of Southeast Asia, (2) reports of peacetime operational and training emergency ejections, and (3) structured interviews with aircrewmen flying the F-14 fighter aircraft was gathered. Analyses of the information indicates that requirements include: (1) maintenance or enhancement of performance and sensory capabilities (vision, audition, and cognition) of critical importance for Navy missions, (2) protection against the unexpected, excessive, and sustained acceleration forces encountered in advanced aircraft, (3) provision of both fire protection and fire retardant systems and (4) use of automated systems as feasible to counter effects of periods of altered consciousness. GRA

N87-22410*# National Aeronautics and Space Administration, Washington, D.C.
NASA INFORMATION SCIENCES AND HUMAN FACTORS PROGRAM Annual Report, 1984
Lee B. Holcomb, Duncan E. McIver, John D. DiBattista, Ronald L. Larsen, Melvin D. Montemerlo, Ken Wallgren, Marty Sokoloski, and Dick Wasicko May 1985 190 p
(NASA-TM-87569; NAS 1.15:87569) Avail: NTIS HC A09/MF A01 CSCL 05H

This report contains FY 1984/85 descriptions and accomplishments in six sections: Computer Science and Automation, Controls and Guidance, Data Systems, Human Factors, Sensor Technology, and Communications. Author

N87-22411*# George Washington Univ., Washington, D.C. Science Communication Studies.
PUBLICATIONS OF THE NASA CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) PROGRAM 1984-86
Washington NASA Jun. 1987 29 p
(Contract NASw-3165)
(NASA-CR-4070; NAS 1.26:4070) Avail: NTIS HC A03/MF A01 CSCL 06B

Publications of research sponsored by the NASA CELSS (Controlled Ecological Life Support Systems) Program are listed, along with publications of interest to the Program. The bibliography is divided into the three major divisions of CELSS research: (1) Food Production; (2) Waste Management; and (3) Systems Management and Control. This bibliography is an update of NASA CR-3911 and includes references from 1984 through 1986.
Author

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N87-22412# Los Alamos National Lab., N. Mex.
NUMERICAL COMPUTATION ON MASSIVELY PARALLEL HYPERCUBES
O. A. McBryan 1986 20 p Presented at the 2nd Conference on Hypercube Multiprocessors, Knoxville, Tenn., 29 Sep. 1986
(Contracts DE-AC02-76ER03077; W-7405-eng-36)
(DE87-003740; LA-UR-86-4218; CONF-8609173-9) Avail: NTIS HC A02/MF A01

Described are numerical computations on the Connection Machine, a massively parallel hypercube architecture with 65,536 single-bit processors and 32 Mbytes of memory. A parallel extension of COMMON LISP provides access to the processors and network. The rich software environment is further enhanced by a powerful virtual processor capability, which extends the degree of fine-grained parallelism beyond 1,000,000. Briefly described are the hardware and the principal features of the parallel programming environment. We then present implementations of SOR, multigrid and pre-conditioned conjugate gradient algorithms for solving partial differential equations on the Connection Machine. Despite the lack of floating point hardware, computation rates above 100 megaflops have been achieved in PDE solution. Virtual processors prove to be a real advantage, easing the effort of software development while improving system performance significantly. The software development effort is also facilitated by the fact that hypercube communications prove to be fast and essentially independent of distance. DOE

N87-22413# Yale Univ., New Haven, Conn. Dept. of Computer Science.
AUTOMATED PROBLEM MAPPING: THE CRYSTAL RUNTIME SYSTEM
Joel H. Saltz and Marina C. Chen Jan. 1987 13 p
(Contract N00014-86-K-0926; Grant NSF DCR-81-06181)
(AD-A177563; YALEU/DCS/RR-510) Avail: NTIS HC A02/MF A01 CSCL 09B

The effective utilization of multiprocessors, particularly those with architectures that cannot support shared memory in an efficient way, is currently dependent on the ability of the user to map the problem onto the multiprocessor. In order to obtain high levels of efficiency, this mapping must distribute computational load relatively evenly between the machine's processors and must minimize the effects of interprocessor communication delay on algorithm performance. The need to explicitly designate a problem decomposition and to verify that the decomposition is both correct and has the desired performance characteristics can be a time consuming and error prone task. In cases in which the load distribution of and algorithm cannot be predicted sufficiently well in advance to allow a deterministic decomposition to be specified, it may be necessary to specify a family of problem decompositions along with a procedure for run time load management. While the development of methods for dynamically balancing loads is an active area of current research without the development of automated mapping methods, the implementation of such schemes can be particularly time consuming and difficult. A methodology will be developed that can insulate the user from the considerations required to produce efficient programs for multiprocessor machines while still enabling the user to achieve high levels of performance. Programs will be written in a very high level programming language Crystal. GRA

N87-22414# Lawrence Livermore National Lab., Calif.
SUPERCOMPUTER ENVIRONMENTS FOR HARDWARE AND SOFTWARE TECHNOLOGY FORECAST
S. F. Mendicino, ed. 1987 36 p
(Contract W-7405-eng-48)
(DE87-007523; UCID-20935) Avail: NTIS HC A03/MF A01

The price-performance revolution in microelectronics and the development of cost-effective communication networks have set the stage for an integrated view of large-scale computing. In the next decade, the supercomputer, the mass storage system, the communication network, and the interactive front ends will be viewed as elements of a total hardware environment whose resources are managed by a single distributed operating system. Since much of the burden of providing effective service in such an environment is placed on software, this report describes not only what potentially lies ahead in the various hardware areas, but also operating systems and related software will evolve over the next decade to complement the hardware. DOE

N87-22415*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN INTERACTIVE EDITOR FOR DEFINITION OF TOUCH-SENSITIVE ZONES FOR A GRAPHIC DISPLAY
Burt L. Monroe, III and Denise R. Jones Apr. 1987 38 p
(NASA-TM-89136; NAS 1.15:89136) Avail: NTIS HC A03/MF A01 CSCL 09B

In the continuing effort to develop more efficient man-machine communications methods, touch displays have shown potential as straightforward input systems. The development of software necessary to handle such systems, however, can become tedious. In order to reduce the need for redundant programming, a touch editor has been developed which allows a programmer to interactively define touch-sensitive areas for a graphic display. The information produced during the editing process is written to a data file, which can be accessed easily when needed by an application program. This paper outlines the structure, logic, and use of the editor, as well as the hardware with which it is presently compatible. Author

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N87-22416# Naval Postgraduate School, Monterey, Calif.
THE USE OF A COMPUTER TO OBTAIN FLIGHT MANUAL DATA M.S. Thesis
Chang W. Oh Dec. 1986 88 p
(AD-A176741) Avail: NTIS HC A05/MF A01 CSCL 01B

The one thing among many that must be prepared for every flight is the making of a flight plan. Pilots must use charts or graphs from the flight manual to compute the fuel flow that is essential to flight plan. Since this requires many steps of interpolation to compute the specific conditions that cannot be read directly from flight manual, it is time consuming and increases the probability of making a mistake. This problem obstructs the execution of various mission changes and continuous sorties. A computer program for personal computer or hand-held calculator is developed to compute the desired fuel flow by modifying the equations for an IDEAL airplane. Author (GRA)

N87-22417# Argonne National Lab., Ill.
REPORT OF THE COMPUTER-AIDED ENGINEERING INTEGRATION PROJECT

R. C. Raffenetti, R. A. Amber, P. J. Bertoncini, J. M. Cook, J. H. Mandel, R. J. McMahon, S. K. VanderMast, and J. A. Volmer Feb. 1987 40 p
(Contract W-31109-eng-38)
(DE87-006790; ANL/TM-447) Avail: NTIS HC A03/MF A01

The goal of this project is to investigate, evaluate, and recommend the networking methods and the data exchange standards by which integration of the Intergraph design equipment and other computer-based Laboratory systems will be achieved. Personal computer-based design systems, computer-integrated manufacturing, engineering analysis, graphics output, electronic publishing, applications data interfaces and data communications options are covered. DOE

N87-22418# Oak Ridge National Lab., Tenn.
AUTOMATED SENSITIVITY ANALYSIS: NEW TOOLS FOR MODELING COMPLEX DYNAMIC SYSTEMS
F. G. Pin 1987 9 p Presented at the Energy 87 Conference on Energy Solutions Today for the Nineties, Atlantic City, N.J., 27 Apr. 1987
(Contract DE-AC05-84OR-21400)
(DE87-001821; CONF-870435-1) Avail: NTIS HC A02/MF A01

Sensitivity analysis is an established methodology used by researchers in almost every field to gain essential insight in design and modeling studies and in performance assessments of complex systems. Conventional sensitivity analysis methodologies, however, have not enjoyed the widespread use they deserve considering the wealth of information they can provide, partly because of their prohibitive cost or the large initial analytical investment they require. Automated systems have recently been developed at ORNL to eliminate these drawbacks. Compilers such as GRESS and EXAP now allow automatic and cost effective calculation of sensitivities in FORTRAN computer codes. In this paper, these and other related tools are described and their impact and applicability in the general areas of modeling, performance assessment and decision making for radioactive waste isolation problems are discussed. DOE

N87-22419 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
DATA APPROXIMATION AND SURFACE FITTING
M. G. Cox Nov. 1986 27 p
(NPL-DITC-81/86; ISSN-0262-5369; ETN-87-99802) Copyright Avail: Issuing Activity

Polynomial, spline, and truncated power function data approximation techniques and surface fitting algorithms are reviewed. Methods for which good software is available or is likely to become available in the near future are indicated. The determination of statistical uncertainties associated with computed approximants is discussed. ESA

N87-22420 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
NAG ALGORITHMS FOR THE APPROXIMATION OF FUNCTIONS AND DATA
J. G. Hayes Dec. 1986 19 p
(NPL-DITC-83/86; ISSN-0262-5369; ETN-87-99803) Copyright Avail: Issuing Activity

Approximation algorithms which are currently in the NAG Algorithms Library and those intended for early addition to the library are discussed. All but one are designed for discrete data. Current contents are strongly based on polynomials and cubic splines, for interpolation and least-squares fitting, for curves and for surfaces. Other algorithms interpolate with rational functions, calculate a Pade approximant, and compute l(1) and l infinity solutions to overdetermined systems. The new algorithms fit spline curves and surfaces to discrete data, but automatically choose the knots of the splines. Others interpolate monotonic curve data or scattered surface data. ESA

N87-22421 National Physical Lab., Teddington (England). Div. of Information Technology and Computing.
THE IMPORTANCE OF TIME IN THE SPECIFICATION OF OSI PROTOCOLS: AN OVERVIEW AND BRIEF SURVEY OF THE FORMALISMS
B. Cohen, D. H. Pitt, and J. C. P. Woodcock (Surrey Univ., Guildford, England) Nov. 1986 24 p
(Contract EMRA-82-0424)
(NPL-DITC-78/86; ISSN-0262-5369; ETN-87-99804) Copyright Avail: Issuing Activity

Techniques used to capture time behavior in Open Systems Interconnection (OSI) protocol specifications were assessed. The OSI transport layer has timing requirements which must be addressed. If LOTOS is to be adopted for specification work in this area, then another formalism must be used to cope with the detailed timing requirements. The only formalisms that seem to fit in with the LOTOS viewpoint are the temporal logics. ESA

N87-22422*# Cornell Univ., Ithaca, N.Y. Program of Computer Graphics.
INTERACTIVE COLOR DISPLAY OF 3-D ENGINEERING ANALYSIS RESULTS Final Technical Report, 1 Mar. 1983 - 28 Feb. 1987
John F. Abel, Anthony R. Ingraffea, and Donald P. Greenberg 28 May 1987 6 p
(Grant NAG3-395)
(NASA-CR-180589; NAS 1.26:180589) Avail: NTIS HC A02/MF A01 CSCL 09B

A general approach to three-dimensional postprocessing of engineering analyses is presented. The approach is versatile and may handle the results from a wide range of engineering analysis methods which involve the discretization of continua. To facilitate the understanding of complex three-dimensional numerical models, advanced interactive color postprocessing techniques are introduced. Finite element, finite difference, and boundary element models are evaluated with the prototype postprocessor. The existing color graphics program (POSTPRO3D) was ported to a high-resolution device. Interactive graphic tools were implemented to facilitate qualitative mesh evaluation from a single analysis. A postprocessing environment was design for workstation technology. B.G.

N87-22423* Computer Software Management and Information Center, Athens, Ga.
COSMIC SOFTWARE CATALOG, 1986 EDITION
1986 417 p Sponsored by NASA
(NASA-CR-176274; NAS 1.26:176274) Avail: Issuing Activity CSCL 09B

This publication contains descriptions of the software supplied by NASA's Computer Software Management and Information Center. Abstracts for 1,108 NASA-sponsored computer programs are included. Author

N87-22424# National Aerospace Lab., Tokyo (Japan).
PROGRAMMING TECHNIQUES FOR HIGH-SPEED PROCESSING AND VERIFICATION WITH THE NEC SUPERCOMPUTER SX SYSTEM
Kinuyo Nakamura, Masahiro Yoshida, and Shinichi Mineo 1986 55 p In JAPANESE; ENGLISH summary
(NAL-TR-909; ISSN-0389-4010) Avail: NTIS HC A04/MF A01

Various methods of effective FORTRAN programming to increase vectorization rates and conduct high-speed processing of FORTRAN programs for supercomputers are presented. The methods are used to tune up the National Aerospace Laboratory application software package, AFMESH, which is a two-dimensional grid generation program, and INVERSE, which is a two-dimensional airfoil design program. The tuned-up programs are executed with the NEC supercomputer SX-2 system and computing times compared with the times of the original programs show the usefulness of the methods. Author

N87-22425*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A STRATEGY FOR AUTOMATICALLY GENERATING PROGRAMS IN THE LUCID PROGRAMMING LANGUAGE
Sally C. Johnson Jun. 1987 17 p
(NASA-TM-89094; L-16244; NAS 1.15:89094) Avail: NTIS HC A02/MF A01 CSCL 09B

A strategy for automatically generating and verifying simple computer programs is described. The programs are specified by a precondition and a postcondition in predicate calculus. The programs generated are in the Lucid programming language, a high-level, data-flow language known for its attractive mathematical properties and ease of program verification. The Lucid programming is described, and the automatic program generation strategy is described and applied to several example problems. Author

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

No abstracts in this category.

63 CYBERNETICS

Includes feedback and control threory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N87-22426# Texas Univ., Austin. Dept. of Mechanical Engineering.
A SURVEY OF ADAPTIVE CONTROL TECHNOLOGY IN ROBOTICS
S. Tosunoglu and D. Tesar 1987 10 p Presented at the Workshop on Space Telerobotics, Pasadena, Calif., 20 Jun. 1987
(Contract DE-FG02-86NE-37966)
(DE87-005189; DOE/NE-37966/1; CONF-870134-3) Avail: NTIS HC A02

This paper reviews the previous work on the adaptive control of robotic systems. Although the field is relatively new and does not yet represent a mature discipline, considerable attention for the design of sophisticated robot controllers has occurred. In this presentation, adaptive control methods are divided into model reference adaptive systems and self-tuning regulators with further definition of various approaches given in each class. The similarity and distinct features of the designed controllers are delineated and tabulated to enhance comparative review. DOE

N87-22427# Japan Atomic Energy Research Inst., Tokyo.
COMPUTER CODE ARM1 FOR SOLVING THE INVERSE KINEMATICS OF A SIX-LINK MANIPULATOR ARM
Mar. 1986 91 p
(DE87-701059; JAERI-M-86-059) Avail: NTIS (US Sales Only) HC A05/MF A01

ARM1 is a FORTRAN 77 program for the numerical solutions of the inverse kinematics problems. This paper is a detailed description of the current program (version 1). The code is simple enough for practical use and besides has no particular restrictions except for the specification of memory size. Incorporated checking statements or routine are useful in identifying the accuracies of solutions obtained. DOE

N87-22428*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
ON ROBUST CONTROL DESIGNS FOR INFINITE DIMENSIONAL SYSTEMS Ph.D. Thesis
Wing H. Lee Sep. 1986 216 p
(Grants NAG2-297; AF-AFOSR-0258-82)
(NASA-CR-180598; NAS 1.26:180598; AFOSR-87-0190TR; LIDS-TH-1599; AD-A177649) Avail: NTIS HC A10/MF A01 CSCL 09B

This thesis deals with the robustness of stability of distributed, linear-time-invariant (DLTI) feedback control systems. The main goal is to formulate a practical method for evaluating feedback designs based on the actual DLTI system characteristics. As a result, a design procedure can be developed for DLTI systems to synthesize feedback controllers that are guaranteed to be closed-loop stable. We have developed a robustness characterization for DLTI systems, and have shown that linear quadratic (LQ) optimal control systems have nice robustness properties and can serve as good reference designs for the actual implementation of the feedback controller. We have studied in detail linear hereditary differential systems and a vibration suppression problem for a flexible beam. We stress the study of implementable controllers, which are finite dimensional, in contrast to optimal controllers that are typically infinite-dimensional. However, one can integrate our multivariable robustness results with the LQ optimal control to derive a finite-dimensional suboptimal control law which is closed-loop stable. We show how this can be done by using spatially-sampled measurements along the flexible beam. GRA

N87-22429*# Catholic Univ. of America, Washington, D.C. Dept. of Electrical Engineering.
DEVELOPMENT OF HARDWARES AND COMPUTER INTERFACE FOR A TWO-DEGREE-OF-FREEDOM ROBOT
Charles C. Nguyen and Farhad J. Pooran Jun. 1987 19 p
(Grant NAG5-780)
(NASA-CR-180591; NAS 1.26:180591) Avail: NTIS HC A02/MF A01 CSCL 09B

The research results that were obtained are reviewed. Then the robot actuator, the selection of the data acquisition system, and the design of the power amplifier will be discussed. The machine design of the robot manipulator will then be presented. After that, the integration of the developed hardware into the open-loop system will also be discussed. Current and future research work is addressed. Author

N87-22430# Politecnico di Milano (Italy). Dipt. di Elettronica.
GENERALIZED MINIMUM VARIANCE CONTROL OF MIMO SYSTEMS: A STABILITY RESULT
Riccardo Scattolini and Nicola Schiavoni 1987 11 p
(Rept-87-002; ETN-87-99758) Avail: NTIS HC A02/MF A01

A generalized minimum variance self-tuning control algorithm for square systems is described. The controller embeds an integral action on the error vector. It is shown how an appropriate yet simple choice of design parameters guarantees overall asymptotic stability for open loop and possibly nonminimum phase plants. ESA

N87-22431# Hanford Engineering Development Lab., Richland, Wash.
CLASSICAL COMPUTER ASSISTED INSTRUCTION VERSUS INTELLIGENT COMPUTER ASSISTED INSTRUCTION
P. R. Gardner 1986 21 p Presented at the 27th Conference of the Association for Development of Computer Based Instructional Systems, New Orleans, La., 3 Feb. 1986
(Contract DE-AC06-76FF-02170)
(DE87-005463; HEDL-SA-3459-FP; CONF-860209-2) Avail: NTIS HC A02/MF A01

Computer-aided instruction has two basic designs, a classical construction (CCAI) or a design based on the principles of artificial intelligence (ICAI). These two types of instructions are compared and contrasted. DOE

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N87-22432# Rome Univ. (Italy). Dipt. di Fisica.
ZEROS OF ARBITRARY POLYNOMIALS AS EIGENVALUES OF SIMPLE MATRICES
M. Bruschi 30 May 1986 6 p Submitted for publication
(Preprint-507; ETN-87-99724) Avail: NTIS HC A02/MF A01

An NxN matrix, whose N eigenvalues coincide with the N zeros of the generic polynomial PN(x) of precise degree N, is explicitly defined in terms of N arbitrary numbers yj and of the N values Fi=F(yj) that the logarithmic derivative of PN(x),F(x)=P'N(x)/Pn(x) takes at the N points yj. ESA

N87-22433# Washington Univ., St. Louis, Mo. Dept. of Systems Science and Mathematics.
DEVELOPMENT AND APPLICATION OF THE p-VERSION OF THE FINITE ELEMENT METHOD Annual Report, 30 Oct. 1985 - 30 Oct. 1986
I. N. Katz 29 Oct. 1986 11 p
(Grant AF-AFOSR-0315-82)
(AD-A177317; SSM-8609; AFOSR-87-0231TR) Avail: NTIS HC A02/MF A01 CSCL 12A

The p-version of the finite element method is a new, important, computationally efficient, approach to finite element analysis. It is more robust than the conventional h-version and its rate of convergence, for domains with corners and for other singularity problems, is twice that of the h-version. Hierarchic elements which implement the p-version efficiently have been formulated so as to enforce C sub o or C sub 1 continuity in the planar case, and so as to enforce C sub o continuity in three dimensions. GRA

N87-22434# State Univ. of New York, Stony Brook. Dept. of Mechanical and Aerospace Engineering.
DISTRIBUTED SYSTEM WITH DAMPING: MODAL TESTS AND DIGITAL CONTROL Final Report, 15 Jan. 1985 - 15 Jan. 1986
Daniel J. Inman 20 Jun. 1986 5 p
(Grant AF-AFOSR-0119-85)
(AD-A177319; AFOSR-87-0236TR) Avail: NTIS HC A02/MF A01 CSCL 20K

Experimental test and control equipment is used to perform identification and control experiments on generic flexible structures. The goal is to establish a laboratory capable of verifying control laws for distributed parameter systems. This is done by providing (1) a dynamic test facility coupled to a main frame computer system, (2) a microprocessor development system and (3) various flexible structures, actuators and sensors. As a first step, several identification tests have been performed to measure the dynamic characteristics of a flexible structure. A composite beam was chosen as the test article with emphasis placed on measuring damping. The coupling of the computer aided test system and dynamic analyzer to a main frame computer system extends the use of the equipment to purely research algorithms rather than limiting the use to standard modal testing or modal analysis algorithms. Thus it is possible to use the laboratory to verify algorithms based on distributed parameter models rather than limiting the program to lumped mass models. GRA

N87-22435# Loughborough Univ. of Technology (England). Dept. of Mathematics.
VARIABLE TRANSFORMATION METHODS AND THEIR USE IN GENERAL AND SINGULAR QUADRATURES
V. U. Aihie and G. A. Evans Feb. 1987 23 p
(MR-199) Avail: NTIS HC A02/MF A01

Some less common transformation methods for general and singular quadratures are considered. Efficient methods for computing the transformations themselves are given as these are no longer standard functions and extensive tests are carried out. One object is to investigate whether transformations which yield high order methods with the trapezium rule have advantages over conventional methods. Author

N87-22436# Hull Univ. (England). Dept. of Electronic Engineering.
THE INFINITE ELEMENTARY DIVISORS OF A MATRIX POLYNOMIAL AND IMPLICATIONS
G. E. Hayton, A. C. Pugh, and P. Fretwell (Royal Signals and Radar Establishment, Malvern, England) Jan. 1987 24 p
(MR-197) Avail: NTIS HC A02/MF A01

A new characterization of infinite poles and zeros in terms of a natural extension of the idea of infinite elementary divisors of a matrix pencil to matrix polynomials is developed. It is used to show that two previous descriptions of infinite frequency structure are equivalent. Subsequently, a polynomial matrix transformation which simultaneously preserves the finite and infinite zero structure is presented. Author

N87-22437# Rome Univ. (Italy). Dept. di Fisica.
NONLINEAR MODULATION OF A TRANSVERSALLY TRAPPED MODE
Francesco Calogero and Pierre C. Sabatier (Universite des Sciences et Techniques du Languedoc, Montpellier, France) Dec. 1986 13 p Submitted for publication
(Contract DRET-85-1435)
(PM/86/43; CNRS-040768; Rept-080264) Avail: NTIS HC A02/MF A01

It is shown that, for a large class of nonlinear PDEs in 2+1 dimensions, whose linear parts account for unidirectional dispersive wave propagation of transversally trapped modes, weak nonlinear effects yield consistently a modulation of the wave motion that is generally described by the nonlinear Schrodinger equation. The example of water waves traveling along a beach (edge waves) is discussed briefly. Author

N87-22438# Universite des Sciences et Techniques du Languedoc, Montpellier (France). Lab. de Physique Mathematique.
RECONSTRUCTION AMBIGUITIES OF INVERSE SCATTERING ON THE LINE
P. C. Sabatier Aug. 1986 20 p
(Contract DRET-86-1435)
(PM/86/25; Rept-080264; CNRS-040768) Avail: NTIS HC A02/MF A01

One dimensional scattering problems governed by the Schroedinger equation or by the impedance equation were studied. In the absence of bound states, there exists a class of potentials that is bijectively related with a class of spectral data, i.e., reflection coefficients as a function of energy. On the other hand, it is known in larger classes several examples of different potentials that are consistent with a given reflection coefficient and no true bound state. In is shown that these ambiguities are related with a Darboux-type transformation which is defined on very wide classes of potentials, leaves invariant the Shroedinger equation whereas the reflection coefficient is flipped, and depends on one arbitrary parameter, so that a one parameter family of equivalent potentials is obtained. If potential classes are defined by their leading asymptotic behavior, the transformation takes a potential from one class to another one. The transformation leaves the transmission coefficient invariant but introduces or suppresses zero energy states or half bound states, so that it is not isospectral. Author

N87-22439# Cranfield Inst. of Tech., Bedford (England). Coll. of Aeronautics.
A NEW NUMERICAL TECHNIQUE FOR QUASI-LINEAR HYPERBOLIC SYSTEMS OF CONSERVATION LAWS
E. F. Toro Dec. 1986 60 p
(CAR-86-26; ISBN-0-947767-55-X) Avail: NTIS HC A04/MF A01

A computational method for hyperbolic conservation laws in one space dimension is presented. This technique is based on the Random Choice Method (RCM). The first step is exactly as in RCM with a secondary grid, whereby intercell values at half time levels are provided. The second step completes the solution at time level n + 1 via a finite difference procedure in which intercell fluxes are evaluated using the RCM solution of the first step. The

method can be interpreted as a random generalization of Godunov's method or as a random version of the Richtmeyer two-step Lax-Wendroff method. For the linear advection equation the method can be shown to be second order accurate. Application to the Euler equations, a detonation analog and the linear advection equation show that results are very similar to those obtained by the Lax-Wendroff method. Thus for smooth flows or even for flows containing mild discontinuities the higher order method (HORCM) performs very satisfactorily. More significantly, the method has the potential for further development that can result in a technique capable of providing higher order representation of smooth parts of the flow and absolutely sharp discontinuities such as shocks and contacts. Author

N87-22440# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A SCHEME-BASED SYSTEM FOR BOOLEAN REASONING M.S. Thesis
Mark L. Fausett 8 Dec. 1986 219 p
(AD-A177605; AFIT/GCE/ENG/86D-8) Avail: NTIS HC A10/MF A01 CSCL 09B

The purpose of this thesis is to develop a software system which supports inference and arithmetic operations on knowledge represented as Boolean equations. The goals of this research are: (1) To develop a set of toolbox procedures, extending a the Scheme programming language to include Boolean algebraic and inference operations; (2) To explore and compare several different methods of representing knowledge expressed as a system of Boolean equations. Sphinx is an extension to the Scheme language enabling algebraic and deductive manipulation of knowledge expressible as Boolean equations. The implementation of Sphinx consists of four packages of procedures each reading within a separate environment. Three packages implement abstract data types, each isomorphic to a Boolean algebra whose elements are Boolean functions, using different data structures to represent Boolean functions. These structures include Lisp S-Expressions, explicit sums of products and extended Boolean expansion trees. The fourth package implements translations between strings and Boolean functions. The performance of each representation with regard to various function manipulations is analyzed. An example application, the fault diagnosis of combinational circuits is demonstrated. GRA

N87-22441*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
QUANTITATIVE ANALYSIS OF THE RECONSTRUCTION PERFORMANCE OF INTERPOLANTS
Donald L. Lansing and Stephen K. Park (College of William and Mary, Williamsburg, Va.) May 1987 35 p
(NASA-TP-2688; L-16164; NAS 1.60:2688) Avail: NTIS HC A03/MF A01 CSCL 12A

The analysis presented provides a quantitative measure of the reconstruction or interpolation performance of linear, shift-invariant interpolants. The performance criterion is the mean square error of the difference between the sampled and reconstructed functions. The analysis is applicable to reconstruction algorithms used in image processing and to many types of splines used in numerical analysis and computer graphics. When formulated in the frequency domain, the mean square error clearly separates the contribution of the interpolation method from the contribution of the sampled data. The equations provide a rational basis for selecting an optimal interpolant; that is, one which minimizes the mean square error. The analysis has been applied to a selection of frequently used data splines and reconstruction algorithms: parametric cubic and quintic Hermite splines, exponential and nu splines (including the special case of the cubic spline), parametric cubic convolution, Keys' fourth-order cubic, and a cubic with a discontinuous first derivative. The emphasis in this paper is on the image-dependent case in which no a priori knowledge of the frequency spectrum of the sampled function is assumed. Author

N87-22442 Engineering Sciences Data Unit, London (England).
CONVERSION OF STABILITY DERIVATIVES FOR A GENERAL CHANGE OF BODY AXES
Nov. 1986 10 p
(ESDU-86041; ISBN-0-85679-593-3; ISSN-0141-397X) Avail: ESDU

This Data Item 86041, an addition to the Aerodynamics Subseries, provides equations for the conversion of stability derivatives from one axis system to another. The separate cases of rotation about a fixed origin, and origin translation without rotation are considered. ESDU

N87-22443*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF A PARALLELIZED NONLINEAR ELLIPTIC BOUNDARY VALUE PROBLEM SOLVER WITH APPLICATION TO REACTING FLOWS Final Report
David E. Keyes and Mitchell D. Smooke (Yale Univ., New Haven, Conn.) Apr. 1987 29 p Presented at the 6th International Symposium on Computer Methods for Partial Differential Equations, IMACS Conference, Jun. 1987
(Contracts NAS1-18107; AFOSR-0189-85TR)
(NASA-CR-178274; ICASE-87-21; NAS 1.26:178274) Avail: NTIS HC A03/MF A01 CSCL 12A

A parallelized finite difference code based on the Newton method for systems of nonlinear elliptic boundary value problems in two dimensions is analyzed in terms of computational complexity and parallel efficiency. An approximate cost function depending on 15 dimensionless parameters is derived for algorithms based on stripwise and boxwise decompositions of the domain and a one-to-one assignment of the strip or box subdomains to processors. The sensitivity of the cost functions to the parameters is explored in regions of parameter space corresponding to model small-order systems with inexpensive function evaluations and also a coupled system of nineteen equations with very expensive function evaluations. The algorithm was implemented on the Intel Hypercube, and some experimental results for the model problems with stripwise decompositions are presented and compared with the theory. In the context of computational combustion problems, multiprocessors of either message-passing or shared-memory type may be employed with stripwise decompositions to realize speedup of O(n), where n is mesh resolution in one direction, for reasonable n. Author

N87-22444*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROBLEM SIZE, PARALLEL ARCHITECTURE AND OPTIMAL SPEEDUP Final Report
David M. Nicol and Frank H. Willard Apr. 1987 31 p Presented at the International Conference on Parallel Processing Prepared in cooperation with College of William and Mary, Williamsburg, Va.
(Contract NAS1-18107)
(NASA-CR-178282; ICASE-87-7; NAS 1.26:178282) Avail: NTIS HC A03/MF A01 CSCL 12A

The communication and synchronization overhead inherent in parallel processing can lead to situations where adding processors to the solution method actually increases execution time. Problem type, problem size, and architecture type all affect the optimal number of processors to employ. The numerical solution of an elliptic partial differential equation is examined in order to study the relationship between problem size and architecture. The equation's domain is discretized into n sup 2 grid points which are divided into partitions and mapped onto the individual processor memories. The relationships between grid size, stencil type, partitioning strategy, processor execution time, and communication network type are analytically quantified. In so doing, the optimal number of processors was determined to assign to the solution, and identified (1) the smallest grid size which fully benefits from using all available processors, (2) the leverage on performance given by increasing processor speed or communication network speed, and (3) the suitability of various architectures for large numerical problems. Author

N87-22445*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPROXIMATION OF DISCRETE-TIME LQG COMPENSATORS FOR DISTRIBUTED SYSTEMS WITH BOUNDARY INPUT AND UNBOUNDED MEASUREMENT Final Report
J. S. Gibson and I. G. Rosen (University of Southern California, Los Angeles.) Apr. 1987 31 p Submitted for publication
(Contract NAS1-18107; Grants AF-AFOSR-0309-84; AF-AFOSR-0393-84)
(NASA-CR-178290; ICASE-87-27; NAS 1.26:178290) Avail: NTIS HC A03/MF A01 CSCL 12A

The approximation of optimal discrete-time linear quadratic Gaussian (LQG) compensators for distributed parameter control systems with boundary input and unbounded measurement is considered. The approach applies to a wide range of problems that can be formulated in a state space on which both the discrete-time input and output operators are continuous. Approximating compensators are obtained via application of the LQG theory and associated approximation results for infinite dimensional discrete-time control systems with bounded input and output. Numerical results for spline and modal based approximation schemes used to compute optimal compensators for a one dimensional heat equation with either Neumann or Dirichlet boundary control and pointwise measurement of temperature are presented and discussed. Author

N87-22446*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SPLITTING METHODS FOR LOW MACH NUMBER EULER AND NAVIER-STOKES EQUATIONS Final Report
Saul Abarbanel, Pravir Dutt, and David Gottlieb (Brown Univ., Providence, R. I.) May 1987 28 p Submitted for publication
(Contract NAS1-18107; Grant AF-AFOSR-0303-85)
(NASA-CR-178297; ICASE-87-30; NAS 1.26:178297) Avail: NTIS HC A03/MF A01 CSCL 12A

Examined are some splitting techniques for low Mach number Euler flows. Shortcomings of some of the proposed methods are pointed out and an explanation for their inadequacy suggested. A symmetric splitting for both the Euler and Navier-Stokes equations is then presented which removes the stiffness of these equations when the Mach number is small. The splitting is shown to be stable. Author

N87-22447*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN ALGORITHM FOR SURFACE SMOOTHING WITH RATIONAL SPLINES
James R. Schiess Jun. 1987 17 p
(NASA-TP-2708; L-16272; NAS 1.60:2708) Avail: NTIS HC A02/MF A01 CSCL 12A

Discussed is an algorithm for smoothing surfaces with spline functions containing tension parameters. The bivariate spline functions used are tensor products of univariate rational-spline functions. A distinct tension parameter corresponds to each rectangular strip defined by a pair of consecutive spline knots along either axis. Equations are derived for writing the bivariate rational spline in terms of functions and derivatives at the knots. Estimates of these values are obtained via weighted least squares subject to continuity constraints at the knots. The algorithm is illustrated on a set of terrain elevation data. Author

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N87-22448# Rome Univ. (Italy). Dipt. di Fisica.
ON THE POSSIBLE NONUNIVERSALITY OF CRITICAL BEHAVIOR IN MICELLAR SOLUTIONS
A. Crisanti and L. Peliti 9 Jun. 1986 7 p Submitted for publication
(Preprint-508; ETN-87-99725) Avail: NTIS HC A02/MF A01

The renormalization treatment of the model introduced by Shnidman (1986) to explain the observed nonuniversal behavior of micellar solutions is considered. It is concluded that Shnidman's results do not describe the critical behavior of his model. The origin of this nonuniversality remains therefore an open problem. ESA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N87-22449# Center for Naval Analyses, Alexandria, Va.
SEARCH THEORY
Henry R. Richardson 14 Apr. 1986 29 p
(Contract N00014-83-C-0725)
(AD-A177493; CNA-PP-449) Avail: NTIS HC A03/MF A01 CSCL 12B

Since World War II, the principles of search theory have been applied successfully in numerous important operations. These include the 1966 search for a lost H-bomb in the Mediterranean near Palomares, Spain, the 1968 search for the lost nuclear submarine Scorpion near the Azores, and the 1974 underwater search for unexploded ordnance during clearance of the Suez Canal. The U.S. Coast Guard employs search theory in its open ocean search and rescue planning. Search theory is also used in astronomy, and in radar search for satellites. Numerous additional applications, including those to industry, medicine, and mineral exploration, are discussed in the proceedings of the 1979 NATO Advanced Research Institute on Search Theory and Applications. Applications to biology and machine maintenance and inspection is described in the literature. Further references to the literature are provided in the first section of this document. This is followed in the second section by an illustration of how search theory can be used to solve an optimal search problem. GRA

N87-22450# Air War Coll., Maxwell AFB, Ala.
MORALITY TO STRATEGY: PERSPECTIVES ON OFFENSIVE WEAPONS IN SPACE
James E. Beale Mar. 1986 29 p
(AD-A177635; AU-AWC-86-018) Avail: NTIS HC A03/MF A01 CSCL 15C

Since President Reagan introduced the concept of a Strategic Defense Initiative (SDI) in March 1983, space-based weapons have been a subject of broad national debate. To date, all consideration has focused on defensive applications, yet the technology which permits SDI is equally capable of supporting offensive weapons. This paper proposes increased consideration of offense related space issues. It outlines the moral, political, and military implications of such weapons and identifies several potential applications. The military utility of these weapons is considered in the context of current military strategy. Shortfalls are identified between current capabilities and strategies for power projection, air-land warfare, and limited strategic warfare. For each shortfall, the possible contribution of space-based weapons is considered. The paper reviews space weapon's support requirements and identifies issues associated with institutional advocacy. It concludes by recommending further analysis and debate on the subject of offensive weapons in space. GRA

N87-22451# Air War Coll., Maxwell AFB, Ala.
BATTLE MANAGEMENT IN SPACE
Ralph E. Warner, II May 1986 30 p
(AD-A177763; AU-AWC-86-220) Avail: NTIS HC A03/MF A01 CSCL 15C

Will the battle manager of the future be a human or a computer and where he/it will be located? The sensors, weapons and problems with the missile attack warning systems threat need to be understood before decisions can be made about the future. Technology will drive the decisions and time to make decisions will be key factors in space battle management. We look at when

and how to kill a missile launched either from Soviet soil or space and the myriad of things that must happen before the battle manager can make a decision. The first being that the missile(s) must be detected; then all the information about the missile(s) needs to be passed to the battle manager and all the decision makers in the chain of command including the National Command Authority. It is emphasized that the communication process must be fast and not affected by either jamming or nuclear bursts and it also must be designed so that if a part is destroyed the system is still responsive to the battle manager. Questions such as should only the United States be protected by this system or should it include our allies; and then who are they and should an international body control the systems are asked. The battle manager is to be located in space. GRA

N87-22452*# Boeing Aerospace Co., Seattle, Wash.
SHUTTLE GROUND OPERATIONS EFFICIENCIES/TECHNOLOGIES STUDY (SGOE/T). VOLUME 5: TECHNICAL INFORMATION SHEETS (TIS) Final Report, Jun. 1986 - May 1987
A. L. Scholz, M. T. Hart, and D. J. Lowry 4 May 1987 148 p
(Contract NAS10-11344)
(NASA-CR-180585; NAS 1.26:180585) Avail: NTIS HC A07/MF A01 CSCL 12B

The Technology Information Sheet was assembled in database format during Phase I. This document was designed to provide a repository for information pertaining to 144 Operations and Maintenance Instructions (OMI) controlled operations in the Orbiter Processing Facility (OPF), Vehicle Assembly Building (VAB), and PAD. It provides a way to accumulate information about required crew sizes, operations task time duration (serial and/or parallel), special Ground Support Equipment (GSE). required, and identification of a potential application of existing technology or the need for the development of a new technolgoy item. Author

N87-22453*# Boeing Aerospace Co., Seattle, Wash.
SHUTTLE GROUND OPERATIONS EFFICIENCIES/TECHNOLOGIES STUDY. VOLUME 4: PRELIMINARY ISSUES DATABASE (PIDB) CATALOG Final Report, Jun. 1986 - May 1987
A. L. Scholz, M. T. Hart, and D. J. Lowry 4 May 1987 723 p
(Contract NAS10-11344)
(NASA-CR-180584; NAS 1.26:180584) Avail: NTIS HC A99/MF E03 CSCL 12B

The Preliminary Issues Database (PIDB) was assembled very early in the study as one of the fundamental tools to be used throughout the study. Data was acquired from a variety of sources and compiled in such a way that the data could be easily sorted in accordance with a number of different analytical objectives. The system was computerized to significantly expedite sorting and make it more usable. The information contained in the PIDB is summarized and the reader is provided with the capability to manually find items of interest. Author

N87-22454*# Boeing Aerospace Co., Seattle, Wash.
SHUTTLE GROUND OPERATIONS EFFICIENCIES/TECHNOLOGIES (SGOE/T) STUDY. VOLUME 3: FINAL PRESENTATION MATERIAL Final Report, Jun. 1986 - May 1987
A. L. Scholz, M. T. Hart, and D. J. Lowry 4 May 1987 190 p
(Contract NAS10-11344)
(NASA-CR-180583; NAS 1.26:180583) Avail: NTIS HC A09/MF A01 CSCL 12B

Charts used in the Final Phase 1 Oral Briefing at Kennedy Space Center on April 6, 1987, and to the Space Transportation Architecture Study (SPAS) Interim Program Review (IPS-5) held at MSFC on April 8, 1987, are contained. Topics discussed include: identification of existing or new technologies to reduce cost; management approaches; recommendations for research or development of specific technology for future use; and identification of new management techniques. B.G.

N87-22455*# Boeing Aerospace Co., Seattle, Wash.
SHUTTLE GROUND OPERATIONS EFFICIENCIES/TECHNOLOGIES (SGOE/T) STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report, Jun. 1986 - May 1987
A. L. Scholz, M. T. Hart, and D. J. Lowry 4 May 1987 19 p
(Contract NAS10-11344)
(NASA-CR-180581; NAS 1.26:180581) Avail: NTIS HC A02/MF A01 CSCL 12B

Methods and technolgoy were defined to reduce the overall operations cost of a major space program. Space Shuttle processing at Kennedy Space Center (KSC) was designed as the working model that would be the source of the operational information. Methods of improving efficiency of ground operations were assessed and technology elements that could reduce cost identified. Emphasis is on: (1) specific technology items and (2) management approaches required to develop and support efficient ground operations. Prime study results are to be recommendations on how to achieve more efficient operations and identification of existing or new technology that would make vehicle processing in both the current program and future programs more efficient and, therefore, less costly. Author

N87-22456*# Boeing Aerospace Co., Seattle, Wash.
SHUTTLE GROUND OPERATIONS EFFICIENCIES/TECHNOLOGIES (SGOE/T) STUDY. VOLUME 2: GROUND OPERATIONS EVALUATION Final Report, Jun. 1986 - May 1987
(Contract NAS10-11344)
(NASA-CR-180582; NAS 1.26:180582) Avail: NTIS HC A10/MF A01 CSCL 12B

The Ground Operations Evaluation describes the breath and depth of the various study elements selected as a result of an operational analysis conducted during the early part of the study. Analysis techniques used for the evaluation are described in detail. Elements selected for further evaluation are identified; the results of the analysis documented; and a follow-on course of action recommended. The background and rationale for developing recommendations for the current Shuttle or for future programs is presented. Author

N87-22457*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROBLEMS IN MERGING EARTH SENSING SATELLITE DATA SETS
Paul H. Smith and Michael J. Goldberg Mar. 1987 15 p
(NASA-TM-87820; Rept-87B0275; NAS 1.15:87820) Avail: NTIS HC A02/MF A01 CSCL 12B

Satellite remote sensing systems provide a tremendous source of data flow to the Earth science community. These systems provide scientists with data of types and on a scale previously unattainable. Looking forward to the capabilities of Space Station and the Earth Observing System (EOS), the full realization of the potential of satellite remote sensing will be handicapped by inadequate information systems. There is a growing emphasis in Earth science research to ask questions which are multidisciplinary in nature and global in scale. Many of these research projects emphasize the interactions of the land surface, the atmosphere, and the oceans through various physical mechanisms. Conducting this research requires large and complex data sets and teams of multidisciplinary scientists, often working at remote locations. A review of the problems of merging these large volumes of data into spatially referenced and manageable data sets is presented. Author

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N87-22458# Rome Univ. (Italy). Dipt. di Fisica.
THE WEAK HAMILTONIAN ON THE LATTICE
Luciano Maiani, Guido Martinelli, Giancarlo Rossi, and Massimo

Testa (Istituto Nazionale di Fisica Nucleare, Rome, Italy) 10 Jun. 1986 13 p Submitted for publication Sponsored by the Italian Ministry of Education
(Preprint-509; ETN-87-99726) Avail: NTIS HC A02/MF A01

The renormalized octet weak Hamiltonian on the lattice is constructed in a form suitable for Monte Carlo calculation. A method for computing so-called eye diagrams is proposed. ESA

N87-22459# Rome Univ. (Italy). Dipt. di Fisica.
ANOMALOUS SCALING AND GENERALIZED LYAPUNOV EXPONENTS OF THE ONE DIMENSIONAL ANDERSON MODEL
Giovanni Paladin and Angelo Vulpiani 11 Jun. 1986 25 p Submitted for publication
(Preprint-510; ETN-87-99727) Avail: NTIS HC A02/MF A01

A family of localization lengths sigma bar(q) (corresponding to generalized Lyapunov exponents in a transfer matrix approach) for the one-dimensional discrete Schroedinger equation with diagonal disorder is introduced. It is shown that, at the band edge of the pure system and random bounded potential with zero average, there is a q-dependent crossover in the scaling of Xiq with the disorder amplitude Sigma: for Sigma < or = Sigma bar(q) varies as q to the minus 6th power, Xiq varies as Sigma to the minus 2/3; otherwise Xiq varies as Sigma to the minus 1/2. The limit therefore reproduces the scaling with exponent -2/3, whereas deviations from this scaling law appear at each fixed Sigma if q is enough large. Results involve a multifractal structure of the asymptotic decay of the wave functions. ESA

N87-22460# Rome Univ. (Italy). Dipt. di Fisica.
SCALING LAW FOR THE MAXIMUM LYAPUNOV CHARACTERISTIC EXPONENT OF INFINITE PRODUCT OF RANDOM MATRICES
Giorgio Parisi and Angelo Vulpiani 11 Jun. 1986 8 p Submitted for publication
(Preprint-512; ETN-87-99729) Avail: NTIS HC A02/MF A01

A simple derivation for the scaling behavior of the maximum Lyapunov characteristic exponent lambda of infinite product of symplectic random matrices is presented. The considered random matrices depend on a parameter Sigma and for Sigma = 0 lambda = 0, lambda varies as Sigma to the power Beta is obtained with either Beta = 1/2 or Beta = 2/3 depending on the probability distribution of the matrix elements. The results agree with previous numerical simulation. ESA

N87-22461# Chicago Univ., Ill.
SUPERMANIFOLDS AND SUPER RIEMANN SURFACES
J. M. Rabin Sep. 1986 9 p Presented at the NATO Advanced Research Workshop on Super Field Theories, Vancouver, Canada, 25 Jul. 1986
(Contract DE-AC02-82ER-40073)
(DE87-004578; CONF-860766-2) Avail: NTIS HC A02/MF A01

The theory of super Riemann surfaces is rigorously developed using Rogers' theory of supermanifolds. The global structures of super Teichmueller space and super moduli space are determined. The super modular group is shown to be precisely the ordinary modular group. Super moduli space is shown to be the gauge-fixing slice for the fermionic string path integral. DOE

N87-22462*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LYAPUNOV EXPONENTS FOR INFINITE DIMENSIONAL DYNAMICAL SYSTEMS Final Report
Nessan Mac Giolla Mhuiris Apr. 1987 17 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178291; ICASE-87-28; NAS 1.26:178291) Avail: NTIS HC A02/MF A01 CSCL 12A

Classically it was held that solutions to deterministic partial differential equations (i.e., ones with smooth coefficients and boundary data) could become random only through one mechanism, namely by the activation of more and more of the infinite number of degrees of freedom that are available to such a system. It is only recently that researchers have come to suspect that many infinite dimensional nonlinear systems may in fact possess finite dimensional chaotic attractors. Lyapunov exponents provide a tool for probing the nature of these attractors. This paper examines how these exponents might be measured for infinite dimensional systems. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N87-22463# Sandia National Labs., Albuquerque, N. Mex.
EXPERIMENTAL DETERMINATION OF THE MASS MATRIX USING A CONSTRAINED LEAST SQUARES SOLUTION
D. O. Smallwood and D. L. Gregory 30 Jan. 1987 28 p Presented at the AIAA/ASME Structural Dynamics and Materials Conference, Monterey, Calif., 6 Apr. 1987
(Contract DE-AC04-76DP-00789)
(DE87-005537; SAND-86-1935C; CONF-870479-1) Avail: NTIS HC A03/MF A01

The method uses a sum of weighted acceleration signals to experimentally predict the external force which excites a mechanical system. The predicted force is compared with the measured force and a constrained least squares solution is found for the optimum set of weights for the acceleration measurements. The weights calculated are equivalent to the effective mass of the system at the measurement locations. The method is sensitive to the bandwidth of the excitation and the spatial distribution of the measurement locations. For this reason the weights are calculated as a function of bandwidth and an error measure is calculated at each bandwidth to help evaluate the optimum bandwidth for a particular set of measurements. The use of constraints is strongly recommended to achieve a set of physically realizable weights. Several examples are given to demonstrate the technique. The primary use of the technique to date has been to estimate the dynamic forces acting on non-rigid bodies. DOE

N87-22464# Wisconsin Univ., Madison. Dept. of Physics.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF OPTOGALVANIC EFFECTS Annual Technical Report, 30 Sep. 1985 - 29 Sep. 1986
J. E. Lawler 29 Sep. 1986 26 p
(Grant AF-AFOSR-0328-84)
(AD-A177299; AFOSR-87-0052TR) Avail: NTIS HC A03/MF A01 CSCL 20C

Experimental and theoretical research progress on optogalvanic effects is reported. The most significant achievement is the development of a technique for measuring the current balance (ratio of electron current to ion current) at the surface of a cold cathode. These measurements have now been confirmed by Monte Carlo simulations. Substantial progress toward a detailed quantitative understanding of the cathode fall negative glow region of cold cathode discharges is anticipated. GRA

N87-22465# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
ELECTRONICALLY INDUCED PHASE TRANSFORMATION Final Report, 1 Oct. 1984 - 30 Sep. 1985
Arthur J. Freeman 26 Sep. 1986 8 p
(Grant AF-AFOSR-0024-81)
(AD-A177392; AFOSR-87-0039TR) Avail: NTIS HC A02/MF A01 CSCL 20C

A new technique for determining the electronic structure of bulk solids has been developed by solving Poisson's equation for a general charge density and potential. All contributions to the potential are completely taken into account in the Hamiltonian matrix elements. The high accuracy of this approach allows us to go beyond traditional treatments and to consider the total energy which allows the accurate determination of structural information (lattice parameters, force constants, etc.) and total energy

determinations of the lowest energy phase. The problems treated during this period include: (1) excited state properties of rare-earths and their compounds, (2) room temperature superconductivity in metallic hydrogen under high pressure and the nature of the molecular to metal phase transition in hydrogen under high pressure, (3) total energy theory of mixed valence, (4) electronic structure and superconductivity in the high Tc A15 compounds, and (5) superconductivity and magnetism of C15 intermetallic compounds. GRA

N87-22466*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
BOUNDARY VALUE PROBLEM FOR THE SOLUTION OF MAGNETIC CUTOFF RIGIDITIES AND SOME SPECIAL APPLICATIONS
Larry Edmonds 15 Apr. 1987 77 p
(Contract NAS7-918)
(NASA-CR-180916; JPL-Pub-87-9; NAS 1.26:180916) Avail: NTIS HC A05/MF A01 CSCL 20C

Since a planet's magnetic field can sometimes provide a spacecraft with some protection against cosmic ray and solar flare particles, it is important to be able to quantify this protection. This is done by calculating cutoff rigidities. An alternate to the conventional method (particle trajectory tracing) is introduced, which is to treat the problem as a boundary value problem. In this approach trajectory tracing is only needed to supply boundary conditions. In some special cases, trajectory tracing is not needed at all because the problem can be solved analytically. A differential equation governing cutoff rigidities is derived for static magnetic fields. The presense of solid objects, which can block a trajectory and other force fields are not included. A few qualititative comments, on existence and uniqueness of solutions, are made which may be useful when deciding how the boundary conditions should be set up. Also included are topics on axially symmetric fields. Author

N87-22285# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE TIMING SYSTEM OF THE FUNDAMENTALSTATION WETTZELL (WEST GERMANY) [ZUR ZEITHALTUNG AUF DER FUNDAMENTALSTATION WETTZELL]
Wolfgang Schlueter and Dieter Feil *In its* Repts. on Cartography and Geodesy, Series 1, No. 96 1985 p 25-35 In GERMAN; ENGLISH and FRENCH summaries (For primary document see N87-22282 15-43)
Avail: NTIS HC A03/MF A01

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N87-22467# Georgia Inst. of Tech., Atlanta. Acoustics and Dynamics Research Lab.
A VARIATIONAL PRINCIPLE FOR SOUND RADIATION FROM VIBRATING BODIES
Jerry H. Ginsberg, Allan D. Pierce, and X. F. Wu 14 Nov. 1986 84 p
(Contract N00014-84-K-0713)
(AD-A177349; GTADRL-86-101) Avail: NTIS HC A05/MF A01 CSCL 20A

A variational principle governing the acoustic pressure on the exterior of an arbitrary body is derived from the Kirchhoff Helmholtz integral relation. The principle is valid for acoustic radiation and diffraction problems. The general principle is specialized to the case of a thin body and then illustrated by an example of sound radiation from a flat, rigid, circular disk in transverse oscillation. The variational formulation has the surface pressure as the unknown variable, with the velocity normal to the surface taken as given. The Rayleigh Ritz method is used to determine a solution in terms of truncated expansions of basis functions. The basis functions employed are polynomial and trigonometric functions, and piecewise linear functions leading to a finite element description. The results compare very well with previous analytical investigations. GRA

N87-22468 North Carolina State Univ., Raleigh.
BOUNDARY LAYER CONTROL BY ACOUSTIC MEANS Ph.D. Thesis
Athanasios George Papathanasiou 1986 120 p
Avail: Univ. Microfilms Order No. DA8701760

Large eddies in a turbulent boundary layer can be broken up by a thin ribbon element spanning the flow within the boundary layer. A Large Eddy Break-Up device (LEBU) in a turbulent boundary layer can reduce skin friction drag downstream of the device. In this experimental investigation the effectiveness of the device is found to be enhanced with proper acoustic excitation. An acoustic pulse, phase locked to the incident large eddies and directed at the LEBU can increase large eddy cancellation in the boundary layer. The acoustic input is generateed by processing a hot film anemometer signal obtained downstream of the device. The acoustic excitation can produce increased drag reduction compared to the unexcited LEBU and net drag reduction compared to the unmanipulated flow. Cross-correlation data and turbulence intensity measurements show that acoustic excitation causes eddy cancellation at the trailing edge of the manipulator plate. Flow visualization downstream of the manipulator shows that the reduction of the large scale structure with excitation persists. The effects of the acoustic excitation were found to spread downstream of the LEBU at a moderate angle. Dissert. Abstr.

N87-22469# Los Alamos National Lab., N. Mex.
PROPAGATION OF NEAR-INFRASOUND OVER LONG RANGES
J. P. Mutschlecner and R. W. Whitaker 1986 39 p Presented at the Atmospheric and Meteorological Effects on Low-frequency, Long-range Sound Propagation, Albuquerque, N. Mex., 27 Oct. 1986
(Contract W-7405-eng-36)
(DE87-005095; LA-UR-87-258; CONF-8610228-1) Avail: NTIS HC A03/MF A01

This paper describes the results of basic research on the physics of infrasonic propagation, both for predictive purposes and signal interpretation. The following aspects were considered: (1) attenuation, (2) seasonal effects, (3) wave effects, (4) average velocity, (5) azimuth deviations, (6) coherence, and (7) surface effects. The primary region of interest was approximately 0.1 to Hz with corresponding wavelengths of 3000 to 30 meters. DOE

N87-22470# Lawrence Livermore National Lab., Calif.
A STUDY OF ULTRASONIC SURFACE AND BULK WAVES IN SATURATED POROUS SOLIDS Ph.D. Thesis
M. Mayes Apr. 1986 76 p Prepared in cooperation with Ohio State Univ., Columbus
(Contract W-7405-eng-48)
(DE87-007652; DOE/NBM-7007652; TR-11) Avail: NTIS MF A01

The acoustics of fluid-saturated porous solids were studied. These structures are characterized by the fluid pores and the solid matrix as being each continuous. The structure is typical of many sedimentary rocks and synthetic filtration materials. The thesis contains experimental measurements of bulk waves in Biot solids, especially the slow wave. Plona's measurements are repeated and slow wave properties and detection difficulties are discussed. A wedge technique developed in our laboratory to enhance slow wave detection is also presented. Experimental results of surface wave velocity measurements are presented, using the periodic surface technique, as are experiments performed on various rock samples in an attempt to measure bulk and surface waves in natural materials. DOE

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N87-22471# Rome Univ. (Italy). Dipt. di Fisica.
UNIFIED APPROACH TO STOCHASTIC REPRESENTATIONS IN REACTION KINETICS
A. Mecozzi (Fondazione Ugo Bordoni, Rome, Italy), F. dePasquale, and L. Peliti 29 May 1986 20 p Submitted for publication
(Preprint-505; ETN-87-99723) Avail: NTIS HC A02/MF A01

It is shown that a simple application of the Feynman-Kac formula makes it possible to derive two inequivalent representations of the generating function of the Malthus-Verhulst model as an average over stochastic processes. One representation is the known Poisson one, while the other is denoted as the generalized branching representation. The formalism is used to obtain closed expressions for the generating function. The results are compared with computer implementations of the model. Generalizations to different models are suggested. ESA

N87-22472 National Physical Lab., Teddington (England). Div. of Radiation Science and Acoustics.
PROBLEMS ASSOCIATED WITH THE PRODUCTION OF MONOENERGETIC NEUTRONS USING THE NPL 3.5 MV VAN DE GRAAF ACCELERATOR AND THEIR SOLUTION
J. B. Hunt Dec. 1986 61 p
(NPL-RS(EXT)-86; ISSN-0143-7135; ETN-87-99805) Copyright Avail: Issuing Activity

Contamination of either the accelerator and the associated beam-line system or the neutron-producing target in van de Graaff generators are discussed, and examples determined using the time-of-flight technique are presented. Recommendations which minimize and stabilize the contributions to the overall neutron field due to neutrons produced by ion-beam interactions with these contaminants are made. A method for eliminating these effects based upon the use of two identical, or nearly identical target disks, a foreground one containing the primary target material and a background one containing none of this material is described. To normalize measurements obtained with the two targets to each other prior to subtraction, a current integrator is used as a monitor. Recommendations which maintain the neutron yield per microcoulomb of incident ion-beam current stable in the short and the long term are presented. Examples of the stability that can be achieved are given, together with background corrected time-of-flight data which demonstrate the usefulness of the methods and recommendations. ESA

N87-22473# Universite des Sciences et Techniques de Lille (France). Lab. de Spectroscopie Hertzienne.
CONTRIBUTION TO THE STUDY OF THE ELECTRONIC PROPERTIES OF SEMICONDUCTORS NEAR THEIR TRANSITION CHARACTERISTICS: THE InP EXAMPLE Ph.D. Thesis [CONTRIBUTION A LETUDE DES PROPRIETES ELECTRONIQUE S DES SEMICONDUCTEURS AU VOISINAGE DE TRANSITIONS CARACTERISTIQUES: EXEMPLE DE InP]
Jean-Pierre Spriet 1985 173 p In FRENCH
(ETN-87-99545) Avail: NTIS HC A08/MF A01

Resistivity and mobility studies were carried out under strong magnetic fields in order to study the problems found in the behavior of resistivity and Hall coefficient at low temperatures. Samples of InP doped to concentrations from 4.3 to 420/10 to the 21st power and magnetic fields of up to 11T were used. The conclusions validate the Mott model assuming a discontinuous Anderson transition and the existence of minimum metallic conductivity. ESA

N87-22474# Universite des Sciences et Techniques de Lille (France). Dept. de Physique Fondamentale.
ELECTRONIC STRUCTURES AND RADIATION PROCESSES IN DIATOMIC MOLECULES. THEORETICAL STUDY OF THE POTENTIAL SURFACE OF THE C2-H2 SYSTEM Ph.D. Thesis [STRUCTURES ELECTRONIQUES ET PROCESSUS RADIATIFS DANS LES MOLECULES DIATOMIQUES. ETUDE THEORIQUE DE LA SURFACE DE POTENTIEL DU SYSTEME C2-H2]
Hubert Lavendy 1985 212 p In FRENCH
(ETN-87-99546) Avail: NTIS HC A10/MF A01

Quantic chemistry is applied to study BeO and CN molecules. The analysis includes the study of molecule orbital levels in systems such as the C2-H2 molecule to improve the computing efficiency. Computing the transition probabilities, photodissociation probabilities are derived. A method to compute the potential surfaces of systems including a large number of electrons is developed. ESA

N87-22475# Universite des Sciences et Techniques de Lille (France).
CONTRIBUTION TO THE EXPERIMENTAL AND THEORETICAL STUDY OF NEUTRAL ATOMS ELASTIC DIFFUSION OVER PERIODIC SURFACES AND SURFACES WITH ISOLATED DEFECTS Ph.D. Thesis [CONTRIBUTION A LETUDE EXPERIMENTALE ET THEORIQUE DE LA DIFFUSION ELASTIQUE DATOMES NEUTRES PAR DES SURFACES PERIODIQUES ET DES SURFACES AVEC DES DEFAUTS ISOLES]
Abdelkader Kara 1985 147 p In FRENCH summary
(ETN-87-99547) Avail: NTIS HC A07/MF A01

Copper surfaces are studied. The interaction potential is related to surface electronic density and structure. The diffusion behavior as a function of temperature is examined. The theoretical analysis is performed using the T matrix form with a realistic periodic potential. A model is established and the variations of mirror beam intensities are related to surface defects using numerical simulations. ESA

N87-22476# Rome Univ. (Italy). Dipt. di Fisica.
CONSTITUENT QUARK MODELS FOR HADRONS AND NUCLEI
R. Mignani and D. Prosperi 4 Dec. 1986 86 p Presented at the 1st International Course on Condensed Matter, Bogota, Columbia, 7-18 Jul. 1986
(Nota-Interna-875; ETN-87-99768) Avail: NTIS HC A05/MF A01

Theoretical approaches to deal with the problem of quarks in nuclei, ranging from direct application of QCD to phenomenological quark models are reviewed. The description of the nucleon-nucleon interaction on the basis of the quark-quark interaction, and the consistency between the two apparently alternative pictures of nuclei valid at short distances (in terms of quarks) and at large distances (in terms of meson exchange) need investigation. There is no clear experimental evidence (apart from the EMC effect) for possible effects due to the quark substructure of nuclei. All the effects claimed as possibly ascribable to quark degrees of freedom inside nuclei, either are experimentally disproved or admit an explanation in terms of standard mechanisms. ESA

N87-22477*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NEAR HARTREE-FOCK QUALITY GTO BASIS SETS FOR THE SECOND-ROW ATOMS
Harry Partridge May 1987 78 p Submitted for publication
(NASA-TM-89449; A-87178; NAS 1.15:89449) Avail: NTIS HC A05/MF A01 CSCL 20H

Energy optimized, near Hartree-Fock quality Gaussian basis sets ranging in size from (17s12p) to (20s15p) are presented for the ground states of the second-row atoms for Na(2P), Na(+), Na(-), Mg(3P), P(-), S(-), and Cl(-). In addition, optimized supplementary functions are given for the ground state basis sets to describe the negative ions, and the excited Na(2P) and Mg(3P)

atomic states. The ratios of successive orbital exponents describing the inner part of the 1s and 2p orbitals are found to be nearly independent of both nuclear charge and basis set size. This provides a method of obtaining good starting estimates for other basis set optimizations. Author

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N87-22478# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
OPERA 2: A TEST FACILITY TO STUDY THE THERMOHYDRAULICS OF LIQUID SATURATED SELF HEATED POROUS MEDIA
J.-M. Buchlin and T. VanKoninckxloo Jan. 1986 29 p
(VKI-TM-41; EAT-8602/JMB-TVK/LK; EA-78; ETN-87-99842)
Avail: NTIS HC A03/MF A01

The test facility OPERA 2 was developed to study the post accident heat removal situation of nuclear reactors. Nuclear heat decay in the active debris bed is simulated by the dielectric heating of particulate material. Quantitative visualization of the bed behavior is emphasized. Results illustrate the potential of the experimental approach to support model development. ESA

74 OPTICS

Includes light phenomena; and optical devices.

For lasers see *36 Lasers and Masers.*

N87-22479# Quantel, Orsay (France).
CONJUGATE MIRROR GYROMETER Final Report [GYROMETRE A MIROIR CONJUGE]
Philippe Aubourg, Eric Durand, and Jean Jacques Roland 30 Jul. 1986 84 p In FRENCH
(Contract DRET-84-504)
(Rept-86-T-258; ETN-87-99394) Avail: NTIS HC A05/MF A01

Photorefractive crystals such as BaTiO3 and BSO were used to implement microwave ring oscillation cavities, in order to study the possibility of using the cavities as rotation sensors. The two wave coupling phenomena associated to the crystal use are explained and discussed. The measuring principle is that a difference in rotational oscillator frequency appears due to a nonreciprocal variation of optical path (Sagnac effect). The Faraday effect used in the experiments is another way to create a nonreciprocal variation. The results follow closely the theoretical expectations. ESA

N87-22480# Lawrence Livermore National Lab., Calif.
SOFT X-RAY GENERATION BY THE CHERENKOV EFFECT
M. J. Moran and B. Chang 25 Feb. 1987 20 p Presented at the 10th Werner Bradt Workshop on Penetration Phenomena: Dynamic Actions of Energetic Probes with Condensed Matter, Alicante, Spain, 7 Jan. 1987
(Contract W-7405-eng-48)
(DE87-006241; UCRL-95038; CONF-870155-1) Avail: NTIS HC A02/MF A01

The Cherenkov effect may be used to generate coherent soft X-rays by taking advantage of the dielectric constants of materials in the neighborhood of atomic resonances. The Cherenkov effect usually is not possible for X-rays because the refractive index is less than one for most X-ray frequencies. However, for narrow frequency bands near atomic resonances, the refractive index can exceed unity with values large enough to generate coherent X-rays with efficiencies higher than any other electron-driven technique. The basic physics of the process is discussed and is used to make rough estimates of photon production efficiencies. An exact theoretical description of Cherenkov production in thin foils is used together with recently-measured refractive indices to calculate the emission distributions of 100 eV photons from thin silicon foils. These distributions are found to be roughly consistent with the simple estimates. In addition, unusual behavior by the distributions suggests a technique that can be used to increase dramatically the peak angular intensities. DOE

N87-22481# Allied Bendix Aerospace, Kansas City, Mo.
PARTICLE AND FIBER IDENTIFICATION BY OPTICAL MICROSCOPY Final Report
W. B. Harding Mar. 1987 27 p
(Contract DE-AC04-76DP-00613)
(DE87-006883; BDX-613-3669) Avail: NTIS HC A03/MF A01

The use of optical microscopy for the identification of particulate and fibrous contaminants is explained. Methods are described for acquiring the contaminants from product and other locations and for preparing them for examination. Examples of the applications of optical microscopy to problems are presented. DOE

N87-22482# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DISTORTION-INVARIANT PATTERN RECOGNITION IN NON-RANDOM NOISE, VOLUME 1 M.S. Thesis
William G. Kobel and Timothy Martin Dec. 1986 125 p
(AD-A177598; AFIT/GE/ENG/86D-20-Vol-1) Avail: NTIS HC A06/MF A01 CSCL 05H

A position, scale, and rotation invariant pattern recognition algorithm which is robust in non random cluttered scenes is developed and analyzed. The algorithm's ability to address background noise problems found in target recognition work is examined. Simulation results using realistic aircraft scenes are also presented. GRA

N87-22483# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DISTORTION-INVARIANT PATTERN RECOGNITION IN NON-RANDOM NOISE, VOLUME 2 M.S. Thesis
William G. Kobel and Timothy Martin Dec. 1986 153 p
(AD-A177599; AFIT/GE/ENG/86D-20-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 05H

This appendix contains the Ada software code that was developed and used to implement the algorithms of this thesis. The Ada software code was developed on a VAX 11/780 with VMS operating system. GRA

N87-22484# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PARAMETER ESTIMATION FOR THE BLIND RESTORATION OF BLURRED IMAGERY M.S. Thesis
Murat Cincioglu Sep. 1986 186 p
(AD-A177602; AFIT/GE/ENG/86S-1) Avail: NTIS HC A09/MF A01 CSCL 05H

Methods to estimate the optical transfer function (OTF) of the degradation and the noise-to-signal ratio in a degraded image are presented which use no prior information about the degradation and the noise. Two types of degradations are considered: uniform linear camera motion and out-of-focus camera with circular aperture. The OTF of the out-of-focus camera is estimated by inspection of the spectra of the degraded image and from average over the spectra of subsections of the degraded image. A line estimation method is described to estimate the degrading OTF of the linear camera motion in one direction. An additional method called the logarithmic estimate is also developed. Frequency and space domain estimation methods are developed for the noise-to-signal ratio for the case of additive Gaussian noise. Inverse, Wiener, and power spectrum equalization filters based on these estimates are implemented on a digital computer to restore a variety of degraded images and examples of blind restoration of these degraded images are presented. GRA

N87-22485# Hughes Research Labs., Malibu, Calif.
REAL-TIME IMPLEMENTATION OF NONLINEAR OPTICAL PROCESSING FUNCTIONS Annual Technical Report, 1 Sep. 1985 - 31 Aug. 1986
B. H. Soffer, Y. Owechko, and E. Marom 30 Sep. 1986 45 p
(Contract F49620-84-C-0096)
(AD-A177629; AFOSR-87-0219TR) Avail: NTIS HC A03/MF A01 CSCL 20F

For the past two decades optical data processing (ODP) has promised a vast increase in processing capacity and speed over conventional electronic techniques. This promise has never been fulfilled for several reasons, most notably because of the lack of a practical real-time image modulator, or light valve, and because optical techniques were almost exclusively limited to linear operations. These restrictions have been removed by the development of the liquid-crystal light valve (LCLV) by Hughes Research Laboratories (HRL), and by nonlinear parallel-processing techniques developed by the University of Southern California (USC). Thus, it is important to determine how successfully nonlinear parallel-processing techniques can be implemented in real time with the various LCLVs. In addition, other new optical technologies, highly developed at HRL, such as four-wave mixing and phase conjugation have inspired a novel research direction for this program in the field of optical associative memories and neural networks as models for computing. Here the phase conjugation provides the desired nonlinearities. GRA

N87-22486# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
OPTICAL PATTERN RECOGNITION USING SYNTHETIC DISCRIMINANT FUNCTIONS M.S. Thesis
David L. Neidig Dec. 1986 63 p
(AD-A177656; AFIT/GE/ENG/86D-2) Avail: NTIS HC A04/MF A01 CSCL 05H

This thesis analyzes the applicability of the matched spatial filter to optical pattern recognition when the object has been rotated relative to the filter. Several techniques are introduced to enhance the discrimination efficiency of the matched filter. Energy normalization was applied to compensate for the variance in the reflected energy of targets. This allowed the matched filter to detect the desired target in the presence of bright background noise. A rotation invariant matched filter was constructed using multiple exposure holograms. Correlation averaging was also applied to make the filter rotation invariant. GRA

N87-22487# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
INTERPRETATION OF THREE-DIMENSIONAL MOVEMENT: A DYNAMIC VISION APPROACH Ph.D. Thesis - Toulouse Univ., France
Herve Garnousset 1986 133 p In FRENCH; ENGLISH summary
(LAAS-86-333; ETN-87-99537) Avail: NTIS HC A07/MF A01

A monocular vision method to evaluate the dynamic information in a time sequence of images is presented. The method is based on artificial intelligence techniques and estimates the 3D movement parameters to provide a representation of the 3D environment. A method to evaluate the convergence point of the radial field of vectors induced by the translation movement is presented. Application to the evaluation of rotations is discussed. ESA

N87-22488# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Space Systems Group.
HIGHLY PRECISE THREE-DIMENSIONAL MEASUREMENTS OF COOPERATIVE TARGETS IN THE SHORT RANGE WITH AN OPTICAL SENSOR SYSTEM
Reinhold Lutz 1986 8 p Presented at the 37th International Astronautical Congress, Innsbruck, Austria, 4-11 Oct. 1986 Previously announced in IAA as A87-15807
(MBB-UR-863/86; IAF-86-08; ETN-87-99934) Avail: NTIS HC A02/MF A01

The design criteria, breadboard model, and test results of an opto-electronic sensor system for high precision measurements of attitude and position of cooperative targets are described. Applications include robotics and spacecraft rendezvous and docking. The sensor uses a position sensitive device with intensity modulation coded markings (light spots) at the target. At least three markings are needed to calculate target position and attitude. The trajectories of moving targets can be obtained. Test results show that position resolution is smaller than the wavelength of the light source. ESA

N87-22489# Oak Ridge Gaseous Diffusion Plant, Tenn.
PULSED-POWER-HANDLING CAPABILITY OF OPTICAL FIBERS
S. W. Allison, M. R. Cates, and G. T. Gillies Nov. 1986 14 p Presented at the CPEM Conference, Gaithersburg, Md., 23 Jun. 1986 Prepared in cooperation with Virginia Univ., Charlottesville
(Contract DE-AC05-84OT-21400)
(DE87-003310; K/TS-11793; CONF-860680-2) Avail: NTIS HC A02/MF A01

Crucial issues are presented for quantifying the damage and power handling characteristics of optical fibers for laser beam delivery and sensing as well as communications applications. In addition to the intrinsic surface and bulk damage threshold of a given fiber material, there are other factors to consider in efforts to quantify the onset of damage and/or undesirable effects. Included are non-Gaussian and nonuniform light distribution in the fiber, the nature of the core/cladding interface, and nonlinear phenomena (e.g., self-focusing). These aspects are illustrated by experiments. Theoretical modeling is under way to help elucidate the role of these factors. DOE

N87-22490# Pacific Northwest Labs., Richland, Wash.
RAMAN CHARACTERIZATION OF MOLECULAR BONDING AND PHASE HOMOGENEITY IN THIN OPTICAL FILMS
G. J. Exharos Jul. 1986 9 p Presented at the 30th SPIE Technical Symposium on Optics and Optoelectronic Engineering, San Diego, Calif., 17 Aug. 1986
(Contract DE-AC06-76RL-01830)
(DE87-006400; PNL-SA-14175; CONF-860880-47) Avail: NTIS HC A02

Submicrometer dielectric films have been analyzed by Raman spectroscopic techniques with respect to phase composition and homogeneity. Residual film stress has also been evaluated from measured vibrational band shifts in sol-gel as well as sputter-deposited films using available data from bulk studies of the pressure dependence on Raman frequencies. Dynamic studies of temperature and laser-induced phase transformations have been performed in situ, suggesting the applicability of this technique for film analysis during deposition. The potential advantages and limitations associated with Raman characterization of thin dielectric films will be addressed in this review using examples from current research in this area. DOE

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N87-22491# Los Alamos National Lab., N. Mex.
LARGE SCALE INSTABILITIES AND DYNAMICS OF THE MAGNETOTAIL PLASMA SHEET
J. Birn and K. Schindler (Bochum Univ., West Germany) 1986 23 p Presented at the 1st Huntsville Workshop on Magnetosphere/Ionosphere Plasma Models, Guntersville, Ala., 13 Oct. 1986 Prepared in cooperation with Bochum Univ. (Germany, F.R.).
(Contract W-7405-eng-36)
(DE87-005101; LA-UR-87-183; CONF-8610233-1) Avail: NTIS HC A02/MF A01

The stability properties of the magnetotail current sheet against large scale modes is reviewed in the framework of ideal MHD, resistive MHD, and collisionless Vlasov theory. It appears that the

small deviations from a plane sheet pinch (in particular a magnetic field component normal to the sheet) are important to explain the transition of the tail from a quiet stable state to an unstable dynamic state. It is found that the tail is essentially stable in ideal MHD, but unstable in resistive MHD, while both stable and unstable configurations are found within collisionless theory. The results favor an interpretation where the onset of magnetotail dynamics leading to a sudden thinning of the plasma sheet and the ejection of a plasmoid is caused by the onset of a collisionless instability that either directly leads to the growth of a collisionless tearing mode or via microscopic turbulence to the growth of a resistive mode. The actual onset conditions are not yet fully explored by rigorous methods. The onset may be triggered by local conditions as well as by boundary conditions at the ionosphere or at the magnetopause (resulting from solar wind conditions). DOE

N87-22492# Lawrence Livermore National Lab., Calif.
RADIATION ASSOCIATED WITH AN INERTIAL CONFINEMENT FUSION LASER SYSTEM
M. S. Singh 3 Dec. 1986 12 p Presented at the Midyear Topical Symposium of the Health Physics Society: Health Physics of Radiation-producing Machines, Reno, Nev., 8 Feb. 1987
(Contract W-7405-eng-48)
(DE87-003814; UCRL-94044; CONF-870219-10) Avail: NTIS HC A02/MF A01

The primary objective of the LLNL Laser Fusion Program is to understand and develop the science and technology of inertial confinement fusion. Nova, a 100-TW/100-kJ laser system, has demonstrated efficient compression, ignition, and burn of D-T fusion fuel. The LLNL fusion computer program (LASNEX) and experiments strongly support achieving high gain with the proposed multi-MJ laser system. In this paper, I examine the prompt and residual radiations associated with these laser systems. DOE

N87-22493# Science Applications International Corp., Boulder, Colo. Plasma Research Inst.
ION TRANSPORT IN TOROIDALLY ROTATING TOKAMAK PLASMAS
P. J. Catto, I. B. Bernstein, and M. Tessarotto Feb. 1987 53 p
(Contract DE-AC03-76ET-53057)
(DE87-006729; SAIC-87/1562; PRI-110) Avail: NTIS HC A04/MF A01

An efficient and systematic treatment of classical and neoclassical transport in all regimes of collisionality is formulated which permits toroidal rotation speeds on the order of the ion thermal speed for arbitrary aspect ratio, cross section, and poloidal magnetic field strength. A more convenient but somewhat unconventional form of the reduced kinetic equation is derived that is shown to extend the previous form by properly retaining induced electric fields. The generalized kinetic and moment description is exploited to explicitly evaluate the radial fluxes of toroidal angular momentum and energy in a pure plasma via a variational formulation. The specific results obtained in the Pfirsch-Schlueter regime are substantially more general than previous evaluations and significant improvements are also made in the banana regime. DOE

N87-22494# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
FORMATION OF SHOCKLIKE MODIFIED KORTEWEG-DEVRIES (MKDV) SOLITONS: APPLICATION TO DOUBLE LAYERS
Gerard Chanteur and Michael A. Raadu Dec. 1986 50 p Sponsored by the Swedish Natural Sciences Research Council
(TRITA-EPP-86-14; ISSN-0348-7539; ETN-87-99788) Avail: NTIS HC A03/MF A01

The modified Korteweg-deVries equation having a cubic nonlinearity with a negative coefficient was investigated. The initial value problem with different asymptotic levels, u1 far to the left and u2 far to the right, was studied analytically and numerically. The necessary and sufficient condition u1u2 $<$ is demonstrated for a shocklike solution also named double layer in plasma physics, to form. ESA

N87-22495# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
FILAMENTATION IN LASER PRODUCED PLASMA FOR CONTROLLED THERMONUCLEAR FUSION
S. G. Sajjadi Nov. 1985 42 p
(ETN-87-99830) Avail: NTIS HC A03/MF A01

Numerical studies of beam filamentation in laser produced plasma are presented. This involves the numerical solution of the parabolic Schroedinger equation, coupled with the thermal transport equations for ions and electrons, in two dimensions. The solution of the resulting equation with nonlinear refractive index due to thermal and ponderomotive forces, shows self-focusing and a variety of strong aberration effects. Intensity amplification at the final focus is found to be between one and two orders of magnitude greater than the initial beam intensity, governed by diffraction and aberration effects within the beam. ESA

N87-22496# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
THE HYDRODYNAMICS OF FILAMENTATION IN LASER PRODUCED PLASMAS
S. G. Sajjadi Oct. 1986 83 p
(ETN-87-99831) Avail: NTIS HC A05/MF A01

A two stage numerical study of the filamentation of a laser beam in a plasma is presented. The electromagnetic energy propagation is coupled self-consistently with the plasma hydrodynamics, including the heating and ablation processes. Calculations cover a broad range of conditions which affect self-focusing. Results agree well with results for the ideal density gradients. The self-focusing distance increases as the plasma temperature increases and decreases for the longer laser wavelength. Ponderomotive self-focusing is particularly effective for perturbations with short spatial scale length, typically as small as the wavelength of the beam. Thermal self-focusing however, is less important on these scale lengths, as it is difficult to sustain a thermal pressure gradient over distances comparable or less than an electron mean free path. ESA

N87-22497# Lanchester Polytechnic, Coventry (England). Dept. of Mathematics.
WAVELENGTH DEPENDENCE OF LIGHT FILAMENTATION IN LASER PLASMAS
S. G. Sajjadi Dec. 1986 16 p
(ETN-87-99832) Avail: NTIS HC A02/MF A01

The development of a self-focused light filament in a fully ionized plasma is followed by numerically solving the wave equation in the paraxial approximation. Transient effects in the laser beam and plasma are studied by taking into account, in a self-consistent manner, the proper motion of the plasma in an intense electromagnetic wave. The behavior of light filaments at wavelengths 1054, 527, and 351 nm are compared. ESA

N87-22498# Institut d'Aeronomie Spatiale de Belgique, Brussels.
THE QUIET AND DISTURBED PLASMASPHERE
J. Lemaire 1986 21 p Presented at the AGARD Meeting on the Aerospace Environment at High Altitudes and its Implications for Spacecraft Charging and Communications, The Hague, The Netherlands, 2-7 Jun. 1986
(Aeronomica-Acta-A-313-1986; ISSN-0065-3713; ETN-87-99843) Avail: NTIS HC A02/MF A01

The plasmasphere and the plasmapause are described from an observational point of view. The main properties of this inner magnetospheric region are recalled. The dynamical response of the plasmasphere to enhancements of geomagnetic activity is considered. The peeling off of the nightside plasmasphere at the onset of enhanced magnetospheric convection events is discussed. The dayside refilling mechanism is addressed. ESA

N87-22499# Applied Microwave Plasma Concepts, Encinitas, Calif.
A PROGRAM TO DEVELOP ADVANCED EBT (ELMO BUMPY TORUS) CONCEPTS AND INTERNATIONAL COLLABORATION ON THE BUMPY TORUS CONCEPT Final Report
14 Jan. 1987 170 p
(Contract DE-AC03-82ER-51030)
(DE87-004602; DOE/ER-51030/T2; AMPC-14-023) Avail: NTIS HC A08/MF A01

This project was undertaken to develop innovative concepts for improving the performance of ELMO Bumpy Torus devices in those aspects of plasma confinement that are particularly relevant to an eventual EBT reactor concept. These include effective magnetic utilization using Andreoletti coils, enhanced confinement using positive ambipolar potentials, and attractive divertor concepts that are compatible with formation and maintenance of ELMO rings. Each of the three major objectives was achieved and, except for the divertor studies, documented for publication and presentation at major scientific meetings. This report provides a brief recapitulation of the major results achieved in the form of a collection of those publications, together with this Introduction.
DOE

N87-22500# Rochester Univ., N. Y. Lab. for Laser Energetics.
THERMAL SELF-FOCUSING WITH MULTIPLE BEAMS
R. S. Craxton and R. L. McCrory Jul. 1986 21 p Presented at the 16th Annual Anomalous Absorption Conference, Lake Luzerne, N.Y., 13 Jul. 1986
(Contract DE-FC08-85DP-40200)
(DE87-005917; DOE/DP-40200/32; CONF-8607116-1) Avail: NTIS HC A02/MF A01

Self-focusing in underdense plasmas in the presence of overlapping beams is of interest for multibeam laser-irradiation systems. The hydrodynamics/ray-tracing simulation code SAGE is used to model thermal self-focusing in two-dimensional line-focus geometry with beams incident obliquely at different angles. The conjecture that multiple overlapping beams may suppress self-focusing is investigated for parameters appropriate to reactor-sized targets; in particular, the dependence upon intensity, scale length and pulse width is examined. While the full problem is three-dimensional, insight may be gained from two-dimensional simulations.
DOE

N87-22501# Auburn Univ., Ala.
RECENT ADVANCES IN THE THEORY AND MODELING OF RF HEATING IN INHOMOGENEOUS PLASMAS
D. G. Swanson, S. Cho, C. K. Phillips, D. Q. Hwang, W. Houlberg, and L. Hively (Oak Ridge National Lab., Tenn.) 1986 32 p Presented at the 11th IAEA International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Kyoto, Japan, 12 Nov. 1986 Prepared in cooperation with Princeton Univ., N.J.; California Univ., Davis; Oak Ridge National Lab., Tenn.
(Contracts DE-FG05-85ER53192; DE-AC05-84OR-21400)
(DE87-006664; IAEA-CN-47/F-IV-4; CONF-861106-23-Trans-) Avail: NTIS HC A03/MF A01

The following studies are briefly described: (1) three wave mode coupling near lower hybrid resonance, (2) exact order reduction in mode conversion problems, (3) two-dimensional conversion-parabolic approximation, and (4) transport simulations of ICRF-heated tokamaks.
DOE

N87-22502# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PLASMA HEATING BY A MAGNETOSONIC SHOCK WAVE THROUGH RESONANT ION ACCELERATION
Yukiharu Ohsawa Feb. 1987 41 p
(IPPJ-811; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Resonant wave-particle interactions in magnetosonic shock waves are studied by theory and simulation. The number of ions trapped by a perpendicular laminar shock in a finite beta plasma was evaluated and the amount of shock heating due to resonant ion acceleration obtained in terms of the Mach number and upstream plasma parameters. Some effects of trapped ions on shock waves are also discussed. In addition, it is shown that a laminar oblique shock can reflect some electrons by a magnetic mirror effect, in spite of a large positive potential in the shock region. These theoretical predictions are confirmed by a 1-2/2 dimension, fully relativistic, fully electromagnetic particle simulation with full ion and electron dynamics.
Author

N87-22503# Nagoya Univ. (Japan). Inst. of Plasma Physics.
MONTE CARLO STUDIES OF TRANSPORT IN A REVERSED FIELD PINCH
T. S. Chen and T. Amano Feb. 1987 38 p
(IPPJ-813; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

Transport in a realistic reversed field pinch (RFP) configuration is studied numerically for both of neoclassical and MHD fluctuation case by Monte Carlo simulation. The results indicate that neoclassical transport is one or two order lower than classical transport and thus is not important for RFP plasma. However, electron diffusion coefficient corresponding to a typical MHD fluctuation configuration of Lundquist number S = 10,000 and equilibrium beta = 8% is about 1 million sq cm/sec which is two orders higher than the classical transport, and thus is an important loss mechanism for RFP plasma confinement.
Author

N87-22504# Nagoya Univ. (Japan). Inst. of Plasma Physics.
SELF-ADJUSTING MECHANISM AND PLASMA DYNAMO IN A REVERSED FIELD PINCH
S. Masamune, H. Oshiyama, A. Nagata, H. Arimoto, S. Yamada, and K. I. Sato Feb. 1987 17 p
(IPPJ-814; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

Equilibrium of the STP-3(M) reversed field pinch was studied by changing the discharge conditions. With increasing the magnetic Reynolds number, the values of field reversal ratio, F and pinch parameter, theta, tend to be kept constant by the self adjusting mechanism which is closely related to the plasma dynamo generating the toroidal flux. When only the Ohmic input power was controlled, this self adjusting mechanism keeps the value of inductive volt second divided by the toroidal flux constant and prohibits the plasma from attaining the helical equilibrium state.
Author

N87-22505# Nagoya Univ. (Japan). Inst. of Plasma Phsyics.
HOMEOSTASIS IN PLASMA CONFINEMENT AT BETA CLOSE TO UNITY
Kei-ichi Hirano Feb. 1987 13 p
(IPPJ-815; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

A steady state solution to magnetic confinement system was studied self-consistently to find how energy confinement time is adjusted to meet required exact balancing of injected and flowing out fluxes of particles and energies. It is demonstrated that, in case high power input into a plasma is allowed to ensure <beta> approx 1 state, homeostasis appears and confinement time becomes independent of any transport process.
Author

N87-22506# Nagoya Univ. (Japan). Inst. of Plasma Physics.
MEASUREMENT OF Al-27 (n,2n) Al-26 SUB g-s CROSS SECTIONS AROUND 14 MeV
M. Sasao, T. Hayashi, K. Taniguchi, A. Takahashi, and T. Iida (Osaka Univ., Japan) Dec. 1986 10 p
(IPPJ-805; ISSN-0469-4732) Avail: NTIS HC A02/MF A01

The total cross sections for Al-27 (n,2n) Al-26 sub g.s. (T sup 1/2 = 7.2 x 100,000 yrs) reaction was measured near the threshold energy. The data show a steep energy dependence, and the cross sections at the DT neutron energy are several times smaller than that used in the activation code.
Author

N87-22507# Nagoya Univ. (Japan). Inst. of Plasma Physics.
IGNITION OF DEUTERIUM BASED FUEL CYCLES IN A HIGH BETA SYSTEM
K. Hirano Jan. 1987 64 p
(IPPJ-810; ISSN-0469-4732) Avail: NTIS HC A04/MF A01

A steady state self-consistent plasma modeling applied to a system having less than Beta greater than close to unity, such as Field Reverse Configuration (FRC) or like, is found to be quite effective in solving the problems independently of any anomalous

process and proves the existence of the ignited state of deuterium based fuel cycles. It was found that the pure DD cycle will not ignite so that He-3 and/or tritium must be added as a catalyzer to achieve ignition. The superiority of the complex composed of the master reactor of He-3-Cat.D cycle and the satellite reactor of He-3 enriched DHe-3 cycle was confirmed in constructing a cleaner system yielding smaller amounts of 14 MeV neutrons and to burn the fuel in steady state for long periods of time. In case storage of tritium for He-3 Beta(-) decay, which turned out not to be allowed experimentally, the catalyzed DD cycle was utilized conventionally, although 14 MeV neutron yields will be increased by 35% over the complex. It is demonstrated that advanced fuel cycle reactors can be very simple in construction and compact in size, so that the field strength and the plasma volume of the order of JT-60's may be enough for a 1000 MW power plant.
Author

N87-22508*# Alabama Univ., Huntsville. College of Science.
INVESTIGATION OF BEAM-PLASMA INTERACTIONS Final Report
Richard C. Olsen May 1987 29 p
(Grant NAG3-620)
(NASA-CR-180579; NAS 1.26:180579) Avail: NTIS HC A03/MF A01 CSCL 20I

Data from the SCATHA satellite was analyzed to solve the problems of establishing electrical contact between a satellite and the ambient plasma. The original focus of the work was the electron gun experiments conducted near the geosynchronous orbit, which resulted in observations which bore a startling similarity to observations of the SEPAC experiments on SPACELAB 1. The study has evolved to include the ion gun experiments on SCATHA, a modest laboratory effort in hollow cathode performance, and preparation for flight experiments pertinent to tether technology. These areas are addressed separately. Author

N87-22509*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
INVESTIGATION OF PLASMA CONTACTORS FOR USE WITH ORBITING WIRES Semiannual Report, 1 Jul. - 31 Dec. 1986
Robert D. Estes Jun. 1987 20 p
(Grant NAG9-126)
(NASA-CR-180922; NAS 1.26:180922; SAR-2) Avail: NTIS HC A02/MF A01 CSCL 20I

The effort to determine the size and shape of the hollow cathode cloud emitted from an orbiting system was continued. In addition, the results obtained for the ionospheric wave impedance of a tethered system was applied to the experiments under consideration. The recent plasma chamber experimental results reported by Urrutia and Stenzel are still being considered. The problem is being studied as to how the ionospheric plasma's global response to the moving disturbance presented by the electrodynamic tethered satellite system affects the system's ability to function as a power generator or thruster. Author

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N87-22510# Florida Univ., Gainesville. Dept. of Electrical Engineering.
STUDY OF GROWN-IN DEFECTS AND TRANSPORT PROPERTIES VERSUS GROWTH PARAMETERS IN 4-5 EPITAXIAL FILMS Final Report, Jun. 1981 - Dec. 1986
Sheng S. Li 5 Jan. 1987 89 p
(Grant AF-AFOSR-0187-81)
(AD-A177221; AFOSR-87-0018TR) Avail: NTIS HC A05/MF A01 CSCL 20L

Investigation on the nature of deep-level defects in Gallium Arsenide and Aluminum sub x Gallium sub 1-x Arsenide (e.g., EL2 and DX center) grown under the various conditions has been performed by; (1) modeling the physical origins of EL2 center in GaAs based on the kinetic reaction equations and the analysis of field-enhanced emission rate, (2) correlation of deep-level defects in multi-epilayer GaAs grown by metalorganic chemical vapor deposition to the various growth parameters, (3) determination of field enhanced thermal emission rate of deep-level defects by reverse-biased deep level transient spectroscopy, (4) study on the Be- and Sn- related complex defects in LPE grown Aluminum sub x Gallium sub 1-x Arsenide (0.2 less than x less than 0.5), and (5) accurate determination of very large density of DX center in Sn-doped Aluminum Gallium Arsenide, and (6) effects of DX center and spatial distribution of electrons on the density of two-dimensional electron gas in GaAs/AlGaAs modulation doped heterojunction structure. GRA

N87-22511# Argonne National Lab., Ill. Materials Science and Technology Div.
ATOMIC RESOLUTION STUDIES OF TILT GRAIN BOUNDARIES IN NiO
K. L. Merkle, J. F. Reddy, C. L. Wiley, D. J. Smith, and G. J. Wood (Arizona State Univ., Tempe.) 1986 10 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986 Prepared in cooperation with Arizona State Univ., Tempe
(Contract W-31109-eng-38)
(DE87-004834; CONF-861207-71) Avail: NTIS HC A02/MF A01

The atomic structures of a number of (001) high-angle tilt grain boundaries in NiO bicrystals have been studied by high-resolution electron microscopy (HREM). Crystallinity is always maintained right up to the grain boundary (GB). Grain boundary planes bounded by a (100)-plane are preferred; however, symmetrical facets are also found at each misorientation. A tendency to match atomic planes across the GB is not only observed in symmetrical, but also in asymmetrical, GBs. Structural units can be clearly recognized in symmetrical GBs. Contrast differences suggest that a multiplicity of structural units exists for some GB configurations. Frequently symmetric GBs also show deviations from mirror symmetry. Multislice image simulations indicate that the Fresnel-like contrast associated with HREM GB images is not particularly sensitive to GB relaxation. DOE

N87-22512# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
PREDICTIONS OF ANISOTROPIC SUPERCONDUCTIVITY IN UIr(SUB)3 AND UPt(SUB)3
T. Oguchi, A. J. Freeman, and G. W. Crabtree (Argonne National Lab., Ill.) 1986 15 p Presented at the Anomalous Rare Earths and Actinides, Grenoble, France, 7 Jul. 1986 Prepared in cooperation with Argonne National Lab., Ill.
(Contract W-31109-eng-38)
(DE87-004992; CONF-860746-14) Avail: NTIS HC A02/MF A01

Anisotropic singlet state superconductivity is predicted for UIr3 (an itinerant non-heavy fermion intermetallic) as was done earlier for UPt3 (perhaps the prototype heavy fermion system). In both, this arises from strong Uf-Xd hybridization which yields a highly anisotropic Fermi surface (now confirmed by dHvA experiments of Taillefer et al. on UPt3), electron - phonon interaction, and superconducting energy gap. DOE

N87-22513# Virginia Univ., Charlottesville. Dept. of Physics.
MAGNETIC IMPURITIES IN SUPERCONDUCTORS Performance Report, 1 Jul. 1986 - 31 Aug. 1987
J. Ruvalds 1987 37 p
(Contract DE-FG05-84ER-45113)
(DE87-006338; DOE/ER-45113/3) Avail: NTIS HC A03/MF A01

The primary objectives of this report have involved various phenomena in superconductors, with a goal toward formulating a procedure for finding new materials that function at desirable temperatures and exhibit high critical magnetic fields. Much of the effort was devoted to the investigation of the interaction of rare

earth impurity spins in a system of conduction electrons which may become superconducting. The normal state resistivity of various heavy fermion alloys has been examined in order to determine the fundamental interactions responsible for the competition between magnetic ordering and superconductivity. Also, the initial research effort on possible room temperature superconductivity of metallic hydrogen has been described. Other topics covered in this report have been the investigation of charge and spin-density waves and the study of electron relaxation relations and transient spectroscopy of alpha-Si:H. DOE

N87-22514# Sandia National Labs., Albuquerque, N. Mex.
GROWTH AND CHARACTERIZATION OF GaAs-AlAs SUPERLATTICE ALLOYS
T. J. Drummond, E. D. Jones, H. P. Hjalmarson, and B. L. Doyle 1987 24 p Presented at the SPIE Conference on Growth of Compound Semiconductors, Bay Point, Fla., 22 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE87-006891; SAND-86-2724C; CONF-870385-3) Avail: NTIS HC A02/MF A01

The superlattice bandstructure of short-period GaAs/AlAs superlattices grown by molecular beam epitaxy resembles that of the AlGaAs alloy system. We have studied indirect gap GaAs/AlAs superlattice alloys using X-ray diffraction and pressure dependent magneto-luminescence. Analysis of the X-ray data shows that the AlAs layers are strained to be pseudomorphic with the GaAs substrate. Because the indirect conduction band ground state derives from the AlAs X-point these superlattice alloys must be treated as strained-layer superlattices. Interpretation of luminescence data using Kronig-Penney and tight-binding analyses of the superlattice bandstructure and optical dipole matrix elements shows that this experiment provides a sensitive measure of the conduction band offset for the GaAs/AlAs system. Quantum size effects lift the three-fold degeneracy of the X-point to yield an in-plane X band quantized according to the transverse electron mass (X/sub t/) and a separate X band along the superlattice axis quantized according to the longitudinal electron mass (X sub 1). Strain shifts at the X-points are of the same magnitude as quantum size effect shifts and drive the X/sub t/ band toward lower energies. The effect of strain in the conduction band can be accurately modeled by assuming GaP deformation potentials for the AlAs layers. DOE

N87-22515# Argonne National Lab., Ill.
HREM OF GRAIN BOUNDARIES IN OXIDES
K. L. Merkle Feb. 1987 20 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract W-31109-eng-38)
(DE87-006983; CONF-861207-89) Avail: NTIS HC A02/MF A01

Recent progress in the understanding of the atomic structure of grain boundaries in ionic solids is briefly reviewed with emphasis on the application of the HREM technique to observations of tilt grain boundaries in NiO. The new generation of high-resolution electron microscopes which are capable of a point-to-point resolution of better than 2 A have allowed atomic-scale observations that can be directly compared to theoretical grain boundary models. Agreements and differences between theory and experiment are discussed. The importance and significance of faceting and asymmetrical boundaries is pointed out. DOE

N87-22516# Massachusetts Univ., Amherst. Dept. of Mechanical Engineering.
RAPID SOLIDIFICATION OF SUPERCONDUCTING MATERIALS Final Technical Report
Mireille T. Clapp 1987 38 p
(Contract N00014-85-K-0160)
(AD-A177272) Avail: NTIS HC A03/MF A01 CSCL 20C

The effect of rapid solidification on superconducting materials was studied. A melt spinning apparatus was used to produce both amorphous and metastable crystalline materials. Their critical superconducting parameters temperature (TC), current density (JC) and magnetic field were studied as well as their mechanical properties. The alloys were rapidly quenched into the amorphous state. These were then annealed to form ultrafine grained A-15 tapes. The high JC's were due to the extreme grain refinement. It should be emphasized that these tapes had the added advantage of being flexible. GRA

N87-22517# Stanford Univ., Calif. Center for Integrated Systems.
INTERFACIAL AND BREAKDOWN CHARACTERISTICS OF MOS DEVICES WITH RAPIDLY GROWN ULTRATHIN SiO2 GATE INSULATORS
Mehrdad M. Moslehi, Steven C. Shatas, Krishna C. Saraswat, and James D. Meindl 1986 14 p
(Contract MDA903-80-C-0432)
(AD-A177331) Avail: NTIS HC A02/MF A01 CSCL 20L

Metal-oxide-semiconductor devices fabricated with tungsten/n+ polysilicon composite gates and subhundred-angstrom SiO2 gate insulators grown by rapid thermal oxidation were characterized by various electrical measurements. The as-fabricated devices with unannealed rapidly grown oxides exhibited breakdown characteristics superior to furnace-grown oxides as evidenced by their excellent breakdown uniformity an average breakdown field of 15 MV/cm, and an average breakdown charge density of over 50 C/sq cm at a stress current density of 1 A/sq cm. The preoxidation surface cleaning procedure was observed to affect the charge-to-breakdown and the densities of fixed oxide charges and surface states in these MOS structures. GRA

N87-22518# University of Southern California, Los Angeles. Dept. of Aerospace Engineering.
MOLECULAR BEAM EPITAXIAL GROWTH AND ELECTRICAL AND OPTICAL INVESTIGATIONS OF 3-5 COMPOUND SEMICONDUCTORS Final Scientific Report, 1 Sep. 1983 - 28 Feb. 1985
Anupam Madhukar 22 Dec. 1986 17 p
(Grant AF-AFOSR-0354-83)
(AD-A177487; USCAE-53-4511-2002; AFOSR-87-0269TR) Avail: NTIS HC A02/MF A01 CSCL 20L

A list of capital equipment acquired for updating the Perkin-Elmer 400 molecular beam epitaxial growth system and establishing capabilities for reflection high energy electron diffraction intensity dynamics, spectroscopic ellipsometry in the near Infrared regime, Hall mobility, capacitance voltage and current voltage measurements is provided, along with a description of the salient features of each of these systems. GRA

N87-22519# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
DEFECT REDUCTION IN EPITAXIAL GROWTH USING SUPERLATTICE BUFFER LAYERS Annual Progress Report, 1 Apr. 1985 - 30 Nov. 1986
S. M. Bedair Dec. 1986 20 p
(Grant AF-AFOSR-0201-85)
(AD-A177529; AFOSR-87-0263TR) Avail: NTIS HC A02/MF A01 CSCL 20B

Several superlattice structures, grown by molecular beam epitaxy, have been used to reduce the density of threading dislocations originating from the Gallium Arsenide substrates. Initial results indicate that GaAsP-InGaAs strained layer superlattice buffer layers are effective in reducing dislocation in GaAs grown on silicon substrates. The stability of SLS in electronic devices either as part of the active layers or buffer layers is being addressed. We are currently conducting pioneering work in new ways to deposit superlattices and atomic layer epitaxy without any gas switching. GRA

N87-22520# Army Research Office, Research Triangle Park, N.C.
PROSPECTS FOR RESEARCH ON SEMICONDUCTOR MATERIALS SURFACES
Robert W. Shaw, Jr., John M. Zavada, and Bernard F. Spielvogel 1 Jan. 1987 14 p
(AD-A177608) Avail: NTIS HC A02/MF A01 CSCL 20L

1 Jan. 1987 14 p
(AD-A177608) Avail: NTIS HC A02/MF A01 CSCL 20L

The workshop, Prospects for Research on Semiconductor Materials Surfaces, was held at the Army Research Office, Research Triangle Park, N.C. on November 12, 1986. It was sponsored by ARO and organized by Robert Shaw, John Zavada, and Bernard Spielvogel. The workshop emphasized experiments to probe surface chemistry of semiconductor materials with the eventual goal of improved devices. Participants came from university, industrial, and Army laboratories and discussed current basic research activities, identified neglected research areas with high potential payoff, and developed specific research recommendations. This report provides the summary notes of the workshop. GRA

N87-22521# Cornell Univ., Ithaca, N.Y.
A WORKSHOP ON SELECTIVELY DOPED HETEROSTRUCTURE MATERIALS, DEVICES AND CIRCUITS Abstracts only
L. F. Eastman 21 Jan. 1987 36 p Workshop held in Santa Barbara, Calif., 2-7 Dec. 1984
(Contract N00014-85-G-0156)
(AD-A177692) Avail: NTIS HC A03/MF A01 CSCL 20L

This conference was held to exchange information on the selectively doped heterojunction transistor (SDHT), also called MODFET, HEMT, and TEGFET. There were 64 attendees, including 47 from the USA, 8 from Japan, 6 from France, 2 from W. Germany, and 1 from Belgium. There were just over half from industry, with 6 from U.S. Government, and the remainder from universities. The abstracts of the papers presented are attached to yield a proceedings of the conference. There were several discussion sessions, with one panel session. It included Kiehl of ATT(now IBM), Laviron of Thomson CSF, Mimura of Fujitsu, Harris of Stanford, Heime of Deisburg, and Lee of Rockwell. GRA

N87-22522# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A COMPARISON OF SELECTED REGULAR STRUCTURES IN NMOS (N-CHANNEL METAL OXIDE SEMICONDUCTOR) VLSI (VERY LARGE SCALE INTEGRATED) TECHNOLOGY M.S. Thesis
Raymond J. Schlegelmilch 18 Sep. 1986 89 p
(AD-A177701; AFIT/GCS/ENG/86S-1) Avail: NTIS HC A05/MF A01 CSCL 20L

A four micron N-channel metal oxide semiconductor (NMOS) technology integrated circuit was designed to compare the characteristics of selected regular circuit structures. Circuits were designed in custom, Programmable Logic Array, Modified Programmable Logic Array and Weinberger Array formats. Overviews are provided for the design processes and testing performed. Compilations of the test results and descriptions of the related observations and conclusions are provided. Recommendations are made toward continuing the investigation to provide a broader base of comparison for regular circuit structures. Author (GRA)

N87-22523# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
REALIZATION AND CHARACTERIZATION OF SCHOTTKY SUBMILLIMETER METAL-GaAs DIODES Ph.D. Thesis - Toulouse Univ., France
Kamel Chegroune 1986 136 p In FRENCH; ENGLISH summary
(LAAS-86-349; ETN-87-99538) Avail: NTIS HC A07/MF A01

The optimization of the technology to operate at frequencies of the order of 1 THz is investigated. Schottky diodes appear as the best adapted candidates. The effects of parasitic elements which limit the frequency and the sensitivity are discussed. The manufacturing procedures are examined, studying the factors affecting the quality of the metal-semiconductor interface. The static and dynamic experimental results are described. The technology is not yet at a mass production level, but it is well established. ESA

N87-22524# Lyon-1 Univ. (France).
CONTRIBUTION TO THE METROLOGY OF COMPLEX FLOW. APPLICATION TO THE STUDY OF THE INTERNAL AERODYNAMICS OF ALTERNATING MOTORS Ph.D. Thesis [CONTRIBUTION A LA METROLOGIE DES ECOULEMENTS COMPLEXES, APPLICATION A LETUDE DE LAERODYNAMIQUE INTERNE DES MOTEURS ALTERNATIFS]
Jean-Paul Melinand 1985 145 p In FRENCH
(ETN-87-99541) Avail: NTIS HC A07/MF A01

The principles and applications of laser Doppler anemometry are discussed. Flow measurement in an internal combustion motor by means of laser anemometry is studied and measurement methods are developed. The analysis shows that each complex flow configuration requires a different measurement method. The advantages of laser anemometry as compared to other methods are demonstrated. ESA

N87-22525# Ecole Centrale de Lyon (France).
PASSIVATION OF THE InP SURFACE USING GROUP 5 ELEMENTS FOR METAL-INSULATOR STRUCTURES (MIS) APPLICATIONS Ph.D. Thesis [PASSIVATION DE LA SURFACE DE LInP PAR DES ELE MENTS DE LA COLONNE V POUR STRUCTURES MIS]
Jacques Chave 1987 125 p In FRENCH
(ETN-87-99543) Avail: NTIS HC A06/MF A01

Surface treatments of InP surfaces were studied in order to develop manufacturing procedures appropiate to the implementation of metal-insulator (MIS) technologies. The thermal treatment at 450/500 C under partial pressure maintained until the insulator is applied represents an effective treatment if oxygen contamination is avoided. The potential of arsenic chemical treatments and the utilization of ultrahigh vacuum chambers are discussed. ESA

N87-22526 Paris-Sud Univ., Orsay (France). Inst. d'Electronique Fondamentale.
STUDY OF THE ACTIVE RAMAN AND INFRARED VIBRATION MODES IN NATURAL AND SYNTHETIC QUARTZ SAMPLES Ph.D. Thesis [ETUDE DES MODES DE VIBRATION ACTIFS EN EFFET RAMAN ET EN INFRA-ROUGE, DANS DIFFERENTS ECHANTILLONS DE QUARTZ NATUREL OU SYNTHETIQUE]
Mireille Chapet-Rousseau 1985 268 p In FRENCH summary
(ETN-87-99551) Avail: Issuing Activity

Vibration modes of quartz crystals were compared using the heterodyne effect from the combination of two coherent light beams, of which one is variable in frequency. The laser apparatus developed for the experiments are described. The results show a range of property variations, depending on the origin of the quartz crystal. Large difference between the Raman frequencies observed in a thin sheet or a thick crystal are found. The possible influences of the manufacturing techniques are discussed. ESA

N87-22527# Rome Univ. (Italy). Dipt. di Fisica.
KINETICS OF SALT-INDUCED AGGREGATION IN POLYSTYRENE LATTICES STUDIED BY QUASIELASTIC LIGHT SCATTERING
G. Bolle, C. Cametti, P. Codastefano, and P. Tartaglia 26 Jun. 1986 24 p Prepared in cooperation with CNR, Rome, Italy
(Nota-Interna-867; ETN-87-99760) Avail: NTIS HC A02/MF A01

The kinetics of aggregation of polystyrene particles of 481 nm in a solution of a uni-univalent salt in the concentration range 0.05 to 2.6 M was investigated. Using quasi-elastic light scattering to measure the line width and hence the hydrodynamic radius of the clusters, the value 1.75 + or - 0.003 is found for the fractal dimension of the aggregates in the fast coagulation regime, while the exponential kinetics are recovered with low salt content. ESA

N87-22528*# Claremont Graduate School, Calif.
PARAMETER EXTRACTION AND TRANSISTOR MODELS Final Report

Charles Rykken, Verena Meiser, Greg Turner, and Qi Wang Jun. 1985 63 p
(Contract JPL-956980)
(NASA-CR-180609; JPL-9950-1283; NAS 1.26:180609) Avail: NTIS HC A04/MF A01 CSCL 20L

Using specified mathematical models of the MOSFET device, the optimal values of the model-dependent parameters were extracted from data provided by the Jet Propulsion Laboratory (JPL). Three MOSFET models, all one-dimensional were used. One of the models took into account diffusion (as well as convection) currents. The sensitivity of the models was assessed for variations of the parameters from their optimal values. Lines of future inquiry are suggested on the basis of the behavior of the devices, of the limitations of the proposed models, and of the complexity of the required numerical investigations. B.G.

N87-22529# National Bureau of Standards, Boulder, Colo. Center for Electronics and Electrical Engineering.
ELECTROMECHANICAL PROPERTIES OF SUPERCONDUCTORS FOR HIGH-ENERGY PHYSICS APPLICATIONS
J. W. Elkin, L. F. Goodrich, J. Moreland, E. S. Pittman, and A. F. Clark Dec. 1986 112 p Sponsored by DOE
(PB87-165585; NBSIR-86/3061) Avail: NTIS HC A06/MF A01 CSCL 20L

The report covers the first year of a 33-month project to establish a systematic base of experimental data on electromechanical effects in superconducting wire and cables for high-energy-physics magnet applications. The research is focused in four general research areas; electromechanical relationships in NbTi, studies of NbTi strands extracted from cables, sausaging effects in NbTi, and studies of the NbTi energy gap. GRA

N87-22530# National Bureau of Standards, Gaithersburg, Md. Semiconductor Electronics Div.
SEMICONDUCTOR MEASUREMENT TECHNOLOGY: A BIBLIOGRAPHY OF NBS (NATIONAL BUREAU OF STANDARDS) PUBLICATIONS FOR THE YEARS 1962-1986
J. Walters Feb. 1987 124 p
(PB87-165197; NBSIR-87/3522) Avail: NTIS HC A06/MF A01 CSCL 20L

Reports of work performed at the National Bureau of Standards (NBS) in the field of Semiconductor Measurement Technology are listed. The publications are grouped by author in a given year, with the current year appearing first in the listing. An index by topic area is provided. Each topic is followed by year and reference number of the appropriate publication. For the reader's convenience, a list by author is also given. Most of the publications listed herein resulted from work done as part of the NB Semiconductor Technology Program (STP). The Program serves to focus NBS research on improved measurement technology for the use of the semiconductor device community in specifying materials, equipment, and devices in national and international commerce, and in monitoring and controlling device fabrication and assembly. The research leads to carefully evaluated, well-documented measurement methods, data, reference artifacts, models and theory, and associated technology which when applied by the industry are expected to contribute to higher yields, lower cost, and higher reliability of semiconductor devices and to provide a basis for controlled improvements in fabrication processes and device performance.

N87-22531# Sandia National Labs., Albuquerque, N. Mex.
ATOMISTIC CALCULATION OF STABILITY AND METASTABILITY OF COHERENTLY STRAINED SILICON-LIKE STRUCTURES
B. W. Dodson and P. A. Taylor 1986 12 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract DE-AC04-76DP-00789)
(DE87-002049; SAND-86-1374C; CONF-861207-75) Avail: NTIS HC A02/MF A01

Monte Carlo based microscopic techniques were used to study the stability and metastability of thin coherently strained layers of mismatched silicon-like semiconductor material grown on the (111) silicon surface. The structural energy was calculated using three-body empirical potentials. For layers greater than about 20 A thickness, the critical layer thickness associated with thermodynamic stability is accurately described by the continuum theory of Matthews and Blakeslee. For thinner layers, however, the stability properties vary considerably from those predicted by the continuum theory. The test system is found to be metastable against the nucleation of misfit dislocations to a lattice mismatch of about 11% for a strained layer six monolayers thick, compared to the 4% mismatch stability limit. DOE

N87-22532# Oak Ridge National Lab., Tenn.
CHARGE EXCHANGE PROCESSES BETWEEN HIGHLY CHARGED IONS AND METAL SURFACES
F. W. Meyer, C. C. Havener, S. H. Overbury, K. J. Snowdon, D. M. Zehner, W. Heiland, and H. Hemme 17 Sep. 1986 17 p Presented at the Conference on the Physics of Multiple Charged Ions, Groningen, Netherlands, 17 Sep. 1986 Prepared in cooperation with Osnabrueck Univ., West Germany
(Contract DE-AC05-84OR-21400)
(DE87-005778; CONF-8609252-1) Avail: NTIS MF A01

The interaction of highly charged ions (argon, nitrogen, and oxygen) with metal surfaces (gold single crystal) causes the emission of electrons. Energy spectra of the emitted electrons reveal, for sufficiently high charge states of the projectile, the occurrence of Auger deexcitation of projectile inner shell vacancies brought into the interaction as well as inter-atomic charge exchange leading to the emission of target Auger electrons. DOE

N87-22533# Tennessee Technological Univ., Cookeville. Dept. of Civil Engineering.
THE STRUCTURE OF CONSTITUTIVE EQUATIONS FOR SEMICONDUCTOR DEVICES
G. R. Buchanan, S. P. Girrens, and J. G. Bennett Jan. 1987 8 p Presented at the 2nd International Conference on Constitutive Laws for Engineering Materials, Tucson, Ariz., 5 Jan. 1987 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE87-006052; LA-UR-87-383; CONF-870103-6) Avail: NTIS HC A02/MF A01

The fundamental equations that describe carrier transport in semiconductor materials are developed using the methods of continuum mixture theory and Maxwell's equations for electrodynamics. There are five basic equations that govern the behavior of current flux, electrostatic potential, electrons, and holes. The behavior of the electrical chemical potentials are introduced and their relation to the current flux is discussed. DOE

N87-22534# Sandia National Labs., Albuquerque, N. Mex.
TUNNELS AT THE SILICON/TUNGSTEN INTERFACE: CAUSES AND CURES
R. S. Blewer, T. J. Headley, and M. E. Tracy 1987 4 p Presented at the Workshop on Refractory Metals and Silicides, Aussois, France, 24 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE87-006124; SAND-87-0096C; CONF-870387-1) Avail: NTIS HC A02

The occurrence of 10 nm diameter tunnels in silicon beneath LPCVD tungsten films has been investigated over a wide range of wafer and deposition conditions. Two deposition techniques have been identified which suppress tunnels for wafer conditions studied in this investigation, thus providing an operational regime in which tunnel formation is not an issue. DOE

N87-22535# Sandia National Labs., Albuquerque, N. Mex.
MOLECULAR DYNAMICS SIMULATION OF BEAM DEPOSITION OF LOW-ENERGY (10-100 eV) Si ATOMS ON THE Si(111) SURFACE
B. W. Dodson and P. A. Taylor Mar. 1987 26 p Presented at the SPIE Conference on Growth of Compound Semiconductors,

Bay Point, Fla., 22 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE87-006131; SAND-87-0261C; CONF-870385-5) Avail: NTIS HC A03/MF A01

The deposition of low energy (10 to 100 eV) silicon atoms onto an unreconstructed (111) silicon surface has been studied using molecular dynamics techniques and an accurate empirical potential describing the covalent Si-Si bonding. 10 eV silicon atoms were directed normal and at 60° angles to a silicon (111) substrate. The resulting atomic trajectories and substrate response were studied to determine the energy loss mechanism resulting in capture and the local lattice excitation near and subsequent diffusion of excess vibrational energy away from the impact point. More glancing angles of incidence (5 to 30°) were studied for beam energies of 20 to 100 eV. DOE

N87-22536# Sandia National Labs., Albuquerque, N. Mex.
MOLECULAR-DYNAMICS SIMULATION OF LOW-ENERGY BEAM DEPOSITION OF SILICON
B. W. Dodson 1987 27 p Presented at the 2nd Topical Meeting on Microphysics of Surfaces, Beams and Adsorbates, Santa Fe, N. Mex., 16 Feb. 1987
(Contract DE-AC04-76DP-00789)
(DE87-006132; SAND-87-0358C; CONF-870224-2) Avail: NTIS HC A03/MF A01

The mechanisms controlling low energy (10 to 100 eV) beam deposition of silicon onto a relaxed (111) silicon substrate have been studied using a molecular dynamics technique. The atomic interaction was modeled using a many body empirical potential so that the effects of the covalent Si-Si bonding could be accurately included. Ten eV silicon atoms with near-perpendicular incidence were studied to determine the energy loss mechanism resulting in capture and the local lattice excitation near and subsequent diffusion of excess vibrational energy away from the impact point. Shallower angles of incidence (5°-30°) were studied for beam energies of 20 to 100 eV. For incidence angles less than an energy- and orientation-dependent critical value, a new phenomenon of surface channeling is observed, in which the trajectory of the incoming particle is steered parallel to, and roughly 2 A above, the surface of the substrate by inelastic interaction with the surface atoms. DOE

N87-22537# Sandia National Labs., Albuquerque, N. Mex.
BANDGAP ENERGY PRESSURE COEFFICIENTS IN STRAINED-LAYER STRUCTURES
E. D. Jones, I. J. Fritz, H. P. Hjalmarson, J. E. Schirber, M. C. Smith, R. M. Biefeld, L. R. Dawson, and T. J. Drummond Mar. 1987 16 p Presented at the SPIE Conference on Growth of Compound Semiconductors, Bay Point, Fla., 22 Mar. 1987
(Contract DE-AC04-76DP-00789)
(DE87-006713; SAND-87-0437C; CONF-870385-2) Avail: NTIS MF A01

The hydrostatic-pressure coefficients of the bandgap energies for four different types of semiconductor heterojunction structures were obtained from photoluminescence measurements at 4K and pressures up to 4 kbar. The structures studied were n-type and p-type In/sub x/Ga/sub 1-x/As/GaAs and n-type GaAs/GaP/sub x/As/sub 1-x/ strained-layer superlattices, n-type In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells and an undoped GaAs/AlAs superlattice. The bandgap energies ranged from 1800 MeV for the GaAs/AlAs structure to 1280 MeV for the In/sub x/Ga/sub 1-x/As/GaAs single strained quantum wells. Pressure coefficients for the In/sub x/Ga/sub 1-x/As/GaAs and GaAs/GaP/sub x/As sub 1-x/ structures were found to be in the range of 10 to 12 MeV/kbar. However, the pressure coefficient of the luminescence energy from the GaAs/AlAs superlattice was found to be -2 MeV/kbar. This negative pressure coefficient is consistent with the interpretation that the luminescence is due to a transition between the construction-band X-point in the AlAs layers and the valence-band GAMMA-point in the GaAs layers. DOE

N87-22538# Argonne National Lab., Ill.
CHARACTERIZATION OF Al AND Al-Cr-Al THIN FILMS
O. F. deLima, Y. Lepetre, and M. B. Brodsky Jan. 1987 7 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract W-31109-eng-38)
(DE87-006972; CONF-861207-85) Avail: NTIS HC A02/MF A01

TEM, X-ray diffraction, and electrical resistivity measurements were used to study the microstructure and the growth of Al-Cr-Al film sandwiches, where the individual Al layers were 300 A thick and the Cr thickness was varied between 0 and 10 atomic layers. The base vacuum was around 1.0 x 10 to the -10 torr, substrate temperatures varied between 100 to 350 C, and evaporation rates were 3 A/s for Al and approx. 0.1 to 0.2 A/s for Cr. All Al films had a strong (111) texture and showed a non-percolative island structure at 350 C. The films became connected at lower substrate temperatures, reaching perfect continuity at 100 C. However, electrical conductivity is achieved also for the films deposited at 350 C when one or more atomic layers of Cr are sandwiched between the Al layers. Results for the superconducting critical temperature and resistivity are discussed in terms of Cr diffusion into Al and the film size effect. DOE

N87-22539# Argonne National Lab., Ill.
NANOCONTACT MEASUREMENTS IN SUPERLATTICES
T. Baumann, J. B. Pethica, M. Grimsditch, and I. K. Schuller 1986 5 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986 Prepared in cooperation with Brown, Boveri und Co. Ltd., Baden, Switzerland
(Contract W-31109-eng-38)
(DE87-006974; CONF-861207-87) Avail: NTIS HC A02/MF A01

Many metallic superlattices are known to exhibit dramatic anomalous elastic properties as a function of modulation wavelength. All measurements to date measure either a shear modulus or a longitudinal modulus in the superlattice plane. Here we present a method which also probes longitudinal elastic behavior perpendicular to the layers using a nano-hardness tester. In this method, a diamond tip is indented into the material and both the indentation depth and applied force are constantly monitored during loading and unloading. The elastic properties are extracted from the unloading part of the force versus displacement curve. Contrary to the anomaly found in a shear modulus, no anomaly in Young's modulus was found in the present study on Mo/Ni superlattices. DOE

N87-22540# Argonne National Lab., Ill.
EPITAXIAL FILM GROWTH STUDY OF SINGLE CRYSTAL V/Ce PREPARED BY MOLECULAR-BEAM EPITAXY ON SAPPHIRE
H. Homma, K. Y. Yang, and I. K. Schuller Nov. 1986 7 p Presented at the Materials Research Society Fall Meeting, Boston, Mass., 1 Dec. 1986
(Contract W-31109-eng-38)
(DE87-006976; CONF-861207-83) Avail: NTIS MF A01

The growth of epitaxial films of cerium (Ce)/vanadium (V)/on single crystal sapphires (alpha-Al2O3) was studied by in-situ reflection high energy electron diffraction and x-ray scattering. For the first time Ce(111) single crystal films was grown on V(110)/alpha-Al2O3 (1120) in the Frank-van der Merwe mode. A new epitaxial orientation, different from the well known Nishiyama-Wasserman or Kurdjumov-Sachs orientations is found in the present study. Subsequent V(110) layers grow epitaxially with three equivalent domains. DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N87-22541# Texas Univ., Austin. Center for Particle Theory.
QUANTUM MECHANICS AND SPECTRUM GENERATING GROUPS AND SUPERGROUPS
A. Bohm Apr. 1986 17 p Presented at the Symmetries in Science 2, Carbondale, Ill., 24 Mar. 1986
(Contract DE-FG05-85ER-40200)
(DE87-004491; CONF-8603115-4; CPT-0057) Avail: NTIS HC A02/MF A01

Collective models are reviewed briefly as the physical basis for dynamical groups, particularly for molecular and nuclear physics. To show that collective models for extended relativistic objects can be constructed, the results of a quantal relativistic oscillator are reviewed. An infinite supermultiplet is then used to describe Regge recurrences as yrast states and daughters as radial excitations. DOE

N87-22542# Nationaal Inst. voor Kernfysica en Hoge Energiefysica, Amsterdam (Netherlands). Sectie-H.
DOUBLY GRADED SIGMA MODEL WITH TORSION
J. Kowalski-Glikman (Warsaw Univ., Poland) Aug. 1986 11 p
(NIKHEF-H/86-16; B8675729; ETN-87-99599) Avail: NTIS HC A02/MF A01

Using the Hull-Witten construction it is shown how to introduce torsion to the doubly graded sigma model. This construction is used to find a link between this model and the ten-dimensional supergravity theory in superspace. ESA

N87-22543# Rome Univ. (Italy). Dipt. di Fisica.
INTERMITTENCY IN CHAOTIC SYSTEMS AND RENYI ENTROPIES
Giovanni Paladin and Angelo Vulpiani 11 Jun. 1986 10 p
(Preprint-511; ETN-87-99728) Avail: NTIS HC A02/MF A01

It is shown that the Renyi entropies characterize the temporal intermittency in chaotic systems and are linked to a set of generalized Lyapunov exponents related to the time fluctuations of the responses to slight perturbations on the trajectory. It is indicated how a simple extension of a numerical algorithm proposed by Grassberger and Procaccia (1983) allows to compute these entropies from a signal. ESA

N87-22544# National Bureau of Standards, Gaithersburg, Md. Thermodynamics Div.
THERMODYNAMICS OF HIGH TEMPERATURE MATERIALS Annual Report, 1 Oct. 1985 - 30 Sep. 1986
Stanley Abramowitz 30 Sep. 1986 52 p
(Grant AF-AFOSR-ISSA-86-0035)
(AD-A177405; AFOSR-87-0181TR) Avail: NTIS HC A04/MF A01 CSCL 22B

This research encompasses five tasks each of which treats, either experimentally or theoretically, measurement or interpretation of the high temperature thermophysical behavior of model systems which show potential applications to the environmental resistant materials and the spacecraft survivability programs. Measurements were done, in a specially designed apparatus using state of the art pyrometery, on the triple point of graphite by a pulse heating method. Calculational algorithm bases were expanded to calculate direct radiative interactions among many coupled channels and provide the continuum-continuum matrix elements needed to describe photodissociation phenomena. The relationship of structure and reactivity of graphitic species is studied. The rates and mechanism of ionic polymerization in highly unsaturated organic compounds, structures and thermochemistry of relevant ions, photodissociation of the polymeric ions, and the repair which generates polymeric ions after photodissociation have been studied. Development of apparatus and techniques to study the molecular basis for laser induced vaporization of refractory materials such as graphite continues. GRA

N87-22545# Rome Univ. (Italy). Dipt. di Fisica.
INTRODUCTION TO THE MATHEMATICAL THEORY OF ANDERSON LOCALIZATION
F. Martinelli and E. Scoppola 16 Oct. 1986 135 p
(Nota-Interna-871; ETN-87-99764) Avail: NTIS HC A07/MF A01

The mathematical methods needed to prove the Anderson localization in multidimensional systems are reviewed. Ergodic properties of the spectrum and the density of states; proof of localization for large coupling constant through the analysis of the structure of the typical configurations of the random potential; exponential decay of Green's functions: the Frohlich and Spencer construction; probabilistic estimates; the one dimensional case; the absence of very slow time evolution; stability of localization under small perturbations of the Hamiltonian; and the continuous random Schroedinger equation are treated. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N87-22546*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS AND SUBSEQUENT ORBITAL INVESTIGATIONS Semiannual Progress Report, 1 Nov. 1986 - 30 Apr. 1987
Richard E. McCrosky and Brian G. Marsden May 1987 16 p
(Grant NGR09-015-212)
(NASA-CR-180606; NAS 1.26:180606; SAPR-27) Avail: NTIS HC A02/MF A01 CSCL 03A

The 155-cm reflector of the Smithsonian Astrophysical Observatory was used for observations of comets and minor planets on 35 nights during October I986- April I987. The distrubution was fairly uniform November-February, but poor weather permitted only 21 observations during March. Table I lists the 423 measurements published (in the MPCs) since the last report, two of them actually made at the very beginning of May I987. Forty-six of the observations refer to comets, 193 to numbered minor planets (numbered, that is, by the end of the semester; only 11 of them refer to minor planets already numbered at the time of the last report), and the remainder to unnumbered minor planets. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N87-22547# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
CALENDAR OF SELECTED AERONAUTICAL AND SPACE MEETINGS
Dec. 1986 128 p
(AGARD-CAL-86/2; ISBN-92-835-0406-2) Avail: NTIS HC A07/MF A01

For each meeting, exhibition, or course, the following information is given: reference number; date; location; title and sponsor; keywords indicating the main topics covered; and contact code for inquiries. B.G.

N87-22548*# National Aeronautics and Space Administration, Washington, D.C.
RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS Summary Fiscal Year Report, 1985
Apr. 1985 187 p
(NASA-TM-87394; NAS 1.15:87394) Avail: NTIS HC A09/MF A01 CSCL 05A

This publication represents the NASA research and technology program for FY 1985. It is a compilation of the Summary portions

of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA. The RTOP summary is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. The first section containing citations and abstracts of the RTOPs is followed by four indexes: Subject, Technical Monitor, Responsible NASA Organization, and RTOP number. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N87-22549 California Univ., Berkeley.
WORKLOAD CHARACTERISTICS AND COMPUTER SYSTEM UTILIZATION IN ONLINE LIBRARY CATALOGS Ph.D. Thesis
Ray Reed Larson 1986 417 p
Avail: Univ. Microfilms Order No. DA8624828

The problems of measuring and evaluating the performance of online library catalog systems are addressed. The structure and functions of online catalogs, and the characteristics and needs of online catalog users are examined. Various methodologies of computer performance evaluation are examined. Specific performance measurements and methods of measurement and modeling for online catalog systems are described. Transaction monitoring, where each command processed by the online catalog system is recorded along with its associated performance measures, was found to offer the greatest advantages for online catalog performance evaluation. This methodology is applied to a large and complex online catalog system, and the results are examined and discussed. The performance characteristics of the system are modelled using regression techniques and the factors that determine system performance are examined. The findings of the research concerning the importance of system workload in determining performance, the role of system and command complexity, and of the utility and value of transaction monitoring as a methodology for evaluation of online catalog systems are discussed. Dissert. Abstr.

N87-22550# Japan Atomic Energy Research Inst., Tokyo.
FUNCTION AND ORGANIZATION OF CPC DATABASE SYSTEM
Feb. 1986 112 p In JAPANESE
(DE87-701022; JAERI-M-86-010) Avail: NTIS (US Sales Only) HC A06/MF A01

It is very time-consuming and expensive work to develop computer programs. Therefore, it is desirable to effectively use the existing program. For this purpose, it is required for researchers and technical staffs to obtain the relevant informations easily. CPC (Computer Physics Communications) is a journal published to facilitate the exchange of physics programs and of the relevant information about the use of computers in the physics community. There are about 1300 CPC programs in JAERI computing center, and the number of programs is increasing. A new database system (CPC database) has been developed to manage the CPC programs and their information. Users obtain information about all the programs stored in the CPC database. Also users can find and copy the necessary program by inputting the program name, the catalogue number and the volume number. In this system, each operation is done by menu selection. Every CPC program is compressed and stored in the database; the required storage size is one third of the non-compressed format. Programs unused for a long time are moved to magnetic tape. The present report describes the CPC database system and the procedures for its use. DOE

N87-22551# General Accounting Office, Washington, D. C.
SPACE OPERATIONS: NASA'S USE OF INFORMATION TECHNOLOGY. REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
Apr. 1987 67 p
(GAO/IMTEC-87-20; B-226577) Avail: NTIS HC A04/MF A01

An overview of the information technology that is critical to the missions of NASA are provided. Planning, development, and use of information for three areas (Space Transportation System, space stations, and unmanned space exploration) are discussed. B.G.

N87-22552# Naval Postgraduate School, Monterey, Calif.
AN ANALYSIS OF THE INGRES DATABASE MANAGEMENT SYSTEM APPLICATIONS PROGRAM DEVELOPMENT TOOLS AND PROGRAMMING ENVIRONMENT M.S. Thesis
James F. DeStael Dec. 1986 123 p
(AD-A177287) Avail: NTIS HC A06/MF A01 CSCL 09B

This thesis examines the databases application programming environment presented by the Applications-By-Forms (ABF) subsystem of the INGRES minicomputer database management system (DBMS). The development of a bibliographical search and report application program is discussed. The operation of the application program is described. Positive and negative aspects of the ABF programming environment are examined. The use of INGRES Query Language (QUEL) and Operation Specification Language (OSL) are also discussed. Author (GRA)

N87-22553# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics/Logistics Dept.
HYPERCHANNEL FILE TRANSFER (HFT) USER INTERFACE COMMANDS (5.0) Final Report
Gary C. Volo 14 Nov. 1986 25 p
(AD-A177630; DTNSRDC/CMLD-86-35) Avail: NTIS HC A02/MF A01 CSCL 09B

The Computer Center at DTNSRDC has recently expanded its HYPERchannel Network to include the Scientific and Engineering (S&E) VAX/VMS Computer Systems. S&E VAX users can access the HYPERchannel Network by HYPERchannel File Transfer (HFT) Facility User Interface Commands which are a local extension of Digital Equipment Corporation's Digital Command Language (DCL). HFT allows users to enter DCL-like commands which execute the appropriate lower level routines contained in the DTNSRDC HYPERchannel Run Time Library. These are fully documented in DTNSRDC technical report number CMLD-86-25, entitled HYPERchannel Run Time Library V2.0 User's Guide. This paper describes the HFT Facility and is broken down into two sections. The HFT User's Guide discusses the available HFT commands, their function and syntactical definition. Since the only remote node currently available via HFT is the CDC Cyber-170 825, all examples in the User's Guide section refer to communications with the CDC processor. GRA

N87-22554# Iowa Univ., Iowa City.
A DESIGN OPTIMIZATION SYSTEM WITH CENTRAL DATABASE FOR FRAMED STRUCTURES Annual Technical Report, Jul. 1984 - Jun. 1986
Saadoun S. AL-Saadoun and Jasbir S. Arora 30 Jun. 1986 303 p
(Grant AF-AFOSR-0322-82)
(AD-A177837; ODL-86-21; AFOSR-87-0252TR) Avail: NTIS HC A14/MF A01 CSCL 13M

A Structural Design Optimization System (S-DOS) is designed and implemented using a central database and AISC code requirements for framed structures. It incorporates modern developments in structural analysis, optimum design, database management and software engineering. The use of the central database and database management system enables the system to be divided into several independent modules. The modules interact through a predesigned database. This type of modular organization of the system makes it easy to create, modify and maintain a module with minimal influence on other modules. Moreover, both the modular organization of the system and the

use to the database management system enable the user to solve large scale problems with reasonable computer memory. Program S-DOS is developed to optimize general structural systems. In this document however, it is implemented to optimize framed structures. GRA

N87-22555 Case Western Reserve Univ., Cleveland, Ohio.
A COMPOSITE MEASURE FOR WEIGHTING DATABASES IN DEFENSE, ENGINEERING AND SCIENCE Ph.D. Thesis
Robert John Rittenhouse 1986 298 p
Avail: Univ. Microfilms Order No. DA8702080

The primary problem is to propose a composite measure as a technique for measuring the relevancy of databases. The databases are characterized as single units by the measure of closeness C sub m values. The measure of closeness consists of two weighted factors: (1) a relevance factor, and (2) a descriptive factor. The relevance factor is the sum of the recall and precision ratios. The descriptive factor is the sum of the weighted properties of each file as follows: (1) subject coverage (2) thesaurus strength, (3) technical level, (4) subject coding, and (5) length of years searched retrospectively. Two experiments were conducted to test if the measure of closeness may be utilized to select the relevant databases in DIALINDEX searches in the general areas of defense, engineering, and science. Searches were conducted in seven sample topics: (1) composites, (2) missiles, (3) rockets, (4) sonar, (5) torpedoes, (6) underwater acoustics, and (7) underwater weapons. For each of the seven topics, online searches were performed on a group of databases. Databases, ranked according to C sub m values, were compared with their corresponding databases ranked by retrievals from DIALINDEX, a Dialog multidatabase file. Dissert. Abstr.

N87-22556# Office of Management and Budget, Washington, D.C.
FIVE-YEAR PLAN FOR MEETING THE AUTOMATIC DATA PROCESSING AND TELECOMMUNICATIONS NEEDS OF THE FEDERAL GOVERNMENT, VOLUME 1 Final Report
Sep. 1986 364 p Prepared in cooperation with General Services Administration, Washington, D.C. and Commerce Dept., Washington, D.C.
(PB87-153326) Avail: NTIS HC A16/MF A01 CSCL 05B

This is Volume 1 of the 1986 five-year plan for meeting the Federal Government's automatic data processing and telecommunications needs. The volume contains an analysis of information technology resource requirements, descriptions of selected information system and significant agency information initiatives. The volume also contains a section of information issues and implications for management. GRA

N87-22557# California Univ., Berkeley. Lawrence Berkeley Lab.
PHYSICAL DESIGN OF TEMPORAL DATABASES
D. Rotem and A. Segev Jun. 1986 22 p Presented at the 3rd International Conference on Data Engineering, Los Angeles, Calif., 2 Feb. 1987
(Contract DE-AC03-76SF-00098)
(DE87-006146; LBL-21747; CONF-870261-1) Avail: NTIS HC A02

We propose a partitioning scheme of files in a temporal database system, and develop algorithms to minimize the overflow associated with that scheme. The proposed partitioning is suitable for range queries and aggregation operations along the time dimension. Simulation results show that the partitioning algorithms proposed in this paper result in better performance than in the case of a grid-type partitioning. DOE

N87-22558# California Univ., Berkeley. Lawrence Berkeley Lab.
BATCHED INTERPOLATION SEARCHING ON DATABASES
Jian-zhong Li and H. K. T. Wong Feb. 1987 16 p Presented at the 3rd International Conference on Data Engineering, Los Angeles, Calif., 2 Feb. 1987
(Contract DE-AC03-76SF-00098)
(DE87-006932; LBL-22848; CONF-870261-2) Avail: NTIS HC A02/MF A01

This paper examines the effect of batching search requests in the Interpolation Search Algorithm on ordered tables in main-memory as well as in a more typical database environment, i.e., a blocked secondary memory. Experiments are performed on several hybrid interpolation search algorithms over non-uniformly distributed data. The effect of batching on these algorithms is examined in terms of algorithms, analysis and experiments. Algorithms, analytic expressions and experimental results of these extensions are given and described. Analytic expressions of these algorithms are validated by experiments. DOE

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N87-22559*# National Aeronautics and Space Administration, Washington, D.C.
VESTA PROJECT: PHASE 0 REPORT
A. Perret Sep. 1986 75 p Transl. into ENGLISH of "Projet VESTA - Rapport de Phase 0" rept. CNES-CT/PMF/APS/D/305 CNES, Toulouse, France, 18 Oct. 1985 p 1-61 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88515; NAS 1.15:88515; CNES-CT/PMF/APS/D/305)
Avail: NTIS HC A04/MF A01 CSCL 05D

This report presents the results of technical studies conducted at CNES/PMF/APS between October 1984 and September 1985 on the VESTA project. These preliminary studies were conducted to establish mission feasibility in terms ofthe trajectory and the scientific objectives, and to determine the type of interfaces which will be required with the Soviets and to measure the magnitude of French participation. A joint French-Soviet report recommends that the project enter phase A, and was approved by CNES and INTERCOSMOS in September, 1985. The mission analysis is made for a mid-1991 launch, and a development schedule for an end-1992 launch is suggested. The decision to postpone the mission was made during the course of the study. Author

N87-22560# Committee on Appropriations (U. S. House).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT-INDEPENDENT AGENCIES APPROPRIATIONS FOR 1988
Washington GPO 1987 1031 p Hearings before the Subcommittee on HUD-Independent Agencies of the Committee on Appropriations, 100th Congress, 1st Session, 7 Apr. 1987
(GPO-73-418) Avail: Subcommittee on HUD-Independent Agencies

The Federal Budget requests by the National Aeronautics and Space Administration for the Fiscal Year 1988 are discussed. These requests cover the expenditure for returning the Shuttle to flight status; commitments to the space station; space science and applications; space research and technology; space tracking and data systems; institutional programs; and construction and maintenance. B.G.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N87-22561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALIBRATION AND COMPARISON OF THE NASA LEWIS FREE-PISTON STIRLING ENGINE MODEL PREDICTIONS WITH RE-1000 TEST DATA
Steven M. Geng 1987 22 p Proposed for presentation at the 22nd Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA, ANS, ASME, SAE, IEEE, ACS and AIChE
(NASA-TM-89853; E-3520; NAS 1.15:89853) Avail: NTIS HC A02/MF A01 CSCL 13F

A free-piston Stirling engine performance code is being upgraded and validated at the NASA Lewis Research Center under an interagency agreement between the Department of Energy's Oak Ridge National Laboratory and NASA Lewis. Many modifications were made to the free-piston code in an attempt to decrease the calibration effort. A procedure was developed that made the code calibration process more systematic. Engine-specific calibration parameters are often used to bring predictions and experimental data into better agreement. The code was calibrated to a matrix of six experimental data points. Predictions of the calibrated free-piston code are compared with RE-1000 free-piston Stirling engine sensitivity test data taken at NASA Lewis. Resonable agreement was obtained between the code predictions and the experimental data over a wide range of engine operating conditions. Author

N87-22562*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMOTIVE STIRLING ENGINE DEVELOPMENT PROGRAM: A SUCCESS Final Report
W. K. Tabata 1987 10 p Proposed for presentation at the Intersociety Energy Conversion Engineering Conference, Philadelphia, Pa., 10-14 Aug. 1987; sponsored by AIAA
(Contract DE-AI01-85CE-50112)
(NASA-TM-89892; DOE/NASA/50112-69; E-3579; NAS 1.15:89892) Avail: NTIS HC A02/MF A01 CSCL 13F

The original 5-yr Automotive Stirling Engine Development Program has been extended to 10 years due to reduced annual funding levels. With an estimated completion date of April 1988, the technical achievements and the prospectives of meeting the original program objectives are reviewed. Various other applications of this developed Stirling engine technology are also discussed. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N87-22563 Nebraska Univ., Lincoln.
A STUDY OF SELECTED EARLY-TYPE CONTACT AND SEMIDETACHED SYSTEMS Ph.D. Thesis
Yan-Feng Li 1986 126 p
Avail: Univ. Microfilms Order No. DA8624603

Six early-type binary systems were investigated with the Wilson and Devinney approach of light-curve analysis, i.e.: (1) LY Aur, the six bandpass OAO-2 observations, as well as the ground-based observations, were used in the analysis. The system is found to be a regular Algol system with a mass ratio of 0.56. Absolute dimensions of the system have been calculated employing the photometric mass ratio; (2) IU Aur, photometric observations from 1964 to 1985 were collected and analyzed to study the cause of the increasing depth of minima with time. Both of the astrophysical and geometrical effects were discussed. IU Aur is found to be a regular Algol system with a mass ratio of about 0.68; (3) V367 Cyg, three groups of observations from 1957 to 1973 were analyzed separately. Three contact solutions were secured. Absolute dimensions of the system were calculated with the photometric mass ratio. It is suggested that V367 Cyg is at an evolved contact phase with active mass transfer and/or mass loss; (4) HR 4975, UBV observations were analyzed. Three semidetached solutions for three values of mass ratio (q = 1.10, 1.37, and 1.75) were found. Masses and radii of the two components were estimated from the dynamical paralax and the separation of the visual double of the multiple system; and (5) and (6) TX Cet and RR TrA, the photoelectric observations of the two systems were re-analyzed. Both are found to be regular Algol systems. Masses and radii of components are estimated. Dissert. Abstr.

N87-22564 Illinois Univ., Urbana.
NEW MOLECULAR PROBES OF ASTRONOMICAL SOURCES Ph.D. Thesis
Mark Steven Schenewerk 1986 224 p
Avail: Univ. Microfilms Order No. DA8623404

Three molecules were examined to evaluate their potential for refining the knowledge of astronomical molecular sources. The primary project involved HCO in interstellar molecular clouds. The observational results include the verification of the identity of interstellar HCO, the confirmation of C(+)-HCO correlation, and the detection of an HCO abundance enhancement in the H II-molecular cloud interface region. Comparisons of these results to current molecular cloud models show good agreement between the observed and theoretical abundances. The second project consisted of a search for the HCN dimer in interstellar molecular clouds, (HCN)2, which is bound by van der Waals forces, represents a class of molecules which in not currently considered in interstellar clouds. No detections were made in the nine sources searched for (HCN)2 emission, and a comparison between (HCN)2 and HCN for Ori A indicates that the HCN dimer abundance is insufficient to appreciably affect the chemistry of the interstellar medium. Dissert. Abstr.

N87-22565 Nebraska Univ., Lincoln.
THE CEPHEID TEMPERATURE SCALE Ph.D. Thesis
Terry John Teays 1986 181 p
Avail: Univ. Microfilms Order No. DA8624619

The temperatures of Cepheid variable stars are determined from their energy distributions, using the technique of spectrum scanning. The observations were obtained with Kitt Peak National Observatory's intensified Reticon Scanner and Cerro Tololo Inter-American Observatory's two-channel scanner. Six well-observed Cepheids in galactic open clusters were examined at various phases of their pulsation cycles. Recently determined color excesses, based on the uvby photometry of Schmidt, were used to scale the reddening curves of Nandy and thereby correct the scans for the effects of interstellar reddening. The temperature of each energy distribution was found by matching them to the emergent flux calculated from Kurucz's model atmospheres. B-V color curves, taken from the literature, were used to establish the color index of the Cepheids at the phases for which temperatures were measured. A linear least-squares fit to these data yielded the color temperature relation. T sub eff = 3.904x0.23 (B-V) sub 0. King et al. discussed the Cepheid mass anomaly (i.e., the discrepancy between masses derived from pulsation theory and those obtained from evolutionary theory) and concluded that a

temperature scale as cool as the the one above would resolve this long, standing problem. However, the use of this temperature scale, along with Schmidt's PLC relation and color excesses, normal solar abundances, and Faulkner's formula for the pulsation constant, Q lead to pulsation masses that are still lower than the evolutionary masses. Dissert. Abstr.

N87-22566*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VELOCITY-RESOLVED OBSERVATIONS OF WATER IN COMET HALLEY
Harold P. Larson, D. Scott Davis, Michael J. Mumma, and Harold A. Weaver (Johns Hopkins Univ., Baltimore, Md.) Sep. 1986 19 p
(NASA-TM-88367; Preprint-58; A-86410; NAS 1.15:88367) Avail: NTIS HC A02/MF A01 CSCL 03A

High resolution (lambda/delta lambda approx. = 3 x 10 to the 5th power) near-infrared observations of H2O emission from Comet Halley were acquired at the time of maximum post-perihelion geocentric Doppler shift. The observed widths and absolute positions of the H2O line profiles reveal characteristics of the molecular velocity field in the coma. These results support H2O outflow from a Sun-lit hemisphere or the entire nucleus, but not from a single, narrow jet emanating from the nucleus. The measured pre- and post-perihelion outflow velocities were 0.9 + or - 0.2 and 1.4 + or - 0.2 km/s, respectively. Temporal variations in the kinematic properties of the outflow were inferred from changes in the spectral line shapes. These results are consistent with the release of H2O into the coma from multiple jets. Author

N87-22567*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ABUNDANCE AND DISTRIBUTION OF WATER VAPOR IN JUPITER'S ATMOSPHERE
Gordon L. Bjoraker, Harold P. Larson (Arizona Univ., Tucson.), and Virgil G. Kunde Sep. 1986 72 p
(NASA-TM-88366; Preprint-61; A-86412; NAS 1.15:88366) Avail: NTIS HC A04/MF A01 CSCL 03A

The atmospheric transmission window between 1800 and 2250 cm(-1) in Jupiter's atmosphere was observed from the Kuiper Airborne Observatory (KAO) and by the infrared spectrometer (IRIS) on Voyager. The vertical distribution of H2O was derived for the 1 to 6 bar portion of Jupiter's troposphere. The spatial variation of H2O was measured using IRIS spectra of the Hot Spots in the North and South Equatorial Belts, the Equatorial Zone, and for an average of the North and South Tropical Zones. The H2O column abundance above the 4 bar level is the same in the zones as in the SEB Hot Spots, about 20 cm-amagat. The NEB Hot Spots are desiccated by a factor of 3 with respect to the rest of Jupiter. For an average between -40 to 40 deg latitude, the H2O mole fraction, qH2O, is saturated for P less than 2 bars, qH2O = 4x10 to the -6 in the 2 to 4 bar range and it increases to 3x10 to the -5 at 6 bars. A similar vertical profile applies to the spatially resolved zone and belt spectra, except that H2O falls off more rapidly at P less than 4 bars in the NEB Hot Spots. The massive H2O cloud at 5 bars, T = 273 K, proposed in solar composition models, is inconsistent with the observations. Instead, a thin H2O ice cloud would form at 2 bars, T = 200 K. The O/H ratio in Jupiter, inferred from H2O measurements in both belts and zones at 6 bars, is depleted by a factor of 50 with respect to the Sun. The implications for the origin of Jupiter of globally depleted O/H, but enhanced C/H and N/H, are discussed. Author

N87-22568 Columbia Univ., New York.
A CO SURVEY OF MOLECULAR CLOUDS IN THE SOUTHERN MILKY WAY Ph.D. Thesis
Leonardo BronfmanAguilo 1986 251 p
Avail: Univ. Microfilms Order No. DA8703003

The first out-of-plane CO survey of the southern Milky Way was completed using the Columbia 1.2 m Millimeter-wave Telescope at Cerro Tololo, Chile, and combined with the Northern CO survey made with the Columbia Telescope in New York City to provide homogeneous coverage of the inner Galaxy. From these data the axisymmetric distribution of molecular gas in the Galactic disk for R = 2 to 10 kpc was derived. Although large-scale deviations from azimuthal symmetry are apparent in the H2 density distribution, the mean thickness of the molecular disk is roughly constant from north to south, and a simultaneous analysis of the first and fourth quadrant data shows that about 75% of the molecular gas lies in a well defined ring, with a radius of approximately 6 and a width of approximately 4 kpc. The present axisymmetric analysis is self-consistent in that, unlike the previous ones, it can reproduce the observed longitudinal distribution of CO intensity integrated in velocity and Galactic latitude. The value of the H2 mass here is largely free of systematic instrument errors, because the W(CO) to N(H2) proportionality constant used was calibrated directly from Columbia CO data. A detailed discussion of the telescope's calibration, including a full comparison with other telescopes and the radiation pattern of the antenna, is also presented. Dissert. Abstr.

N87-22569 California Univ., Los Angeles.
A COMPARATIVE STUDY OF THE ALGOL-TYPE BINARIES S CANCRI AND TT HYDRAE Ph.D. Thesis
Paul Bernard Etzel 1986 369 p
Avail: Univ. Microfilms Order No. DA8629887

A comparison is made between the two intermediate-period Algoltype eclipsing binaries S Cancri and TT Hydrae. The latter system shows moderate complications because of circumstellar matter, while the former, much less so. Photoelectric light curves are analyzed with the WINK model by Wood (1971). Spectrophotometry is presented and analyzed to provide realistic temperature determinations. Coude spectroscopy is presented to obtain a consistent description of the stellar components, and to explore the complications by circumstellar matter. For S Cnc, photometric solutions give equivalent volume radii of gamma sub A = 0.0860 and gamma sub B = 0.1880, and an orbital inclination of i = 85.31 deg. The spectrophotometry is indicative of spectral types B9.5 V and phase variables G8 to KO III-IV, and of temperatures T sub A = 10,200 K and T sub B = 5,160 to 4,990 K for the two components, respectively. For TT Hya, photometric solutions give gamma sub A = 0.0894 and gamma sub B = 0.2431 and i = 84.42 deg. The spectrophotometry is indicative of spectral types B9.5 V and phase-variable G9 to K1 III-IV, and of temperatures T sub A = 9,800K and T sub B = 4,850 to 4,670 K for the components, respectively.
Dissert. Abstr.

N87-22570*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASTRONOMIC TELESCOPE FACILITY: PRELIMINARY SYSTEMS DEFINITION STUDY REPORT. VOLUME 2: TECHNICAL DESCRIPTION
Charlie Sobeck, ed. May 1987 400 p
(NASA-TM-89429-Vol-2; A-87172; NAS 1.15:89429-Vol-2) Avail: NTIS HC A17/MF A01 CSCL 03A

The Astrometric Telescope Facility (AFT) is to be an earth-orbiting facility designed specifically to measure the change in relative position of stars. The primary science investigation for the facility will be the search for planets and planetary systems outside the solar system. In addition the facility will support astrophysics investigations dealing with the location or motions of stars. The science objective and facility capabilities for astrophysics investigations are discussed. B.G.

N87-22571*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ASTROMETRIC TELESCOPE FACILITY PRELIMINARY SYSTEMS DEFINITION STUDY. VOLUME 1: EXECUTIVE SUMMARY
Charlie Sobeck Mar. 1987 61 p
(NASA-TM-89429-Vol-1; A-87113; NAS 1.15:89429-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 03A

The Astrometric Telescope Facility (ATF) is a spaceborne observatory proposed for use on the Space Station (SS) as an Initial Operating Capability (IOC) payload. The primary objective of

the ATF will be the search for extrasolar planetary systems and a detailed investigation of any discovered systems. In addition, it will have the capability of conducting other astrophysics investigations; e.g., measuring precise distances and motions of stars within our galaxy. The purposes of the study were to: (1) define mission and system requirements; (2) define a strawman system concept for the facility at the Prephase A level; (3) define the need for additional trade studies or technology development; and (4) estimate program cost for the strawman concept. It has been assumed for the study that the ATF will be a SS payload, will use a SS-provided Coarse Pointing System (CPS), will meet SS constraints, and will make maximum use of existing flight qualified designs or designs to be qualified by the SS program for general SS use. R.J.F.

N87-22572*# Colorado Univ., Boulder. Center for Astrophysics and Space Astronomy.
IUE OBSERVATIONS OF Mg2 EMISSION FORM MIRAS Semiannual Report
Edward W. Brugel 10 May 1987 6 p
(Grant NAG5-350)
(NASA-CR-180603; NAS 1.26:180603) Avail: NTIS HC A02/MF A01 CSCL 03A

A total of 61 well exposed low dispersion LWP observations were obtained from the brightest normal M-type Mira variables around their pulsation cycles. By observing Mg II throughout the cycle, the intent is to determine the shock luminosity and duration, and the density in the upper atmospheres of Miras. The data also provide a mechanism for probing the radiative cooling in postshock regions of the atmosphere as a function of time. A summary of data acquired for IUE programs SRHLW and MGIEB is presented. B.G.

N87-22573*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INFRARED SOURCE CROSS-INDEX, FIRST EDITION
Marion Schmitz (Computer Sciences Corp., Beltsville, Md.), Jaylee M. Mead, and Daniel Y. Gezari Apr. 1987 323 p
(NASA-RP-1182; Rept-87B0058; NAS 1.61:1182) Avail: NTIS HC A14/MF A01 CSCL 03A

The Infrared Source Cross-Index is a listing of correlated infrared source names (and positions) for astronomical objects observed at 1-1000 microns. The source names have been obtained from the database of the first edition of the Catalog of Infrared Observations (CIO: NASA RP 1118), covering observations published through 1982. Additional identifications were located by correlating these names with identifications contained in other machine-readable astronomical catalogs in the NASA National Space Science Data Center (NSSDC). There are some 80,000 different source names in the Cross-Index, corresponding to over 27,000 unique infrared sources. Author

N87-22574# Max-Planck-Inst. fuer Astronomie, Heidelberg (West Germany).
OPTICAL STUDY OF THE STAR-FORMING REGION SHARPLESS 252 (NGC 2175) Ph.D. Thesis - Ruprecht-Karls Univ., Heidelberg, West Germany
Lauri Kristian Haikala 1984 126 p Sponsored by the Finnish Research Council for Natural Sciences, and the Academia Scientiarum Fennica
(ETN-87-99338) Avail: NTIS HC A07/MF A01

The HII region-molecular cloud complex Sharpless 252 and the stars associated with it were studied by Fabry-Perot interferometry, photography, photoelectric and photographic UBVRI photometry, and polarimetry. Stars probably associated with S252 are estimated at 37. The probable ionization sources of the discrete radio sources S252A and C were found. Distance of S252 is 22 + or - 0.3 kpc. Color-magnitude diagrams suggest that star formation was a sequential process. Age of the subcluster is a few million years, of the main cluster 1 million years. Stellar polarizations up to 12% are observed. The wavelength of the maximum polarization is significantly lower, and polarization efficiency higher than usual values for molecular clouds. A blister and/or champagne model can explain the observed features of the molecular cloud and S252A, B, C, E, and F. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N87-22575# Aerospace Corp., El Segundo, Calif.
OBSERVATION OF RECONNECTION PHENOMENA AT SYNCHRONOUS ORBIT
Donald R. Croley, Jr., Joseph F. Fennell, and B. G. Ledley 30 Sep. 1986 76 p
(Contract F04701-85-C-0086)
(AD-A176596; TR-0086(6940-05)-16; SD-TR-86-90) Avail: NTIS HC A05/MF A01 CSCL 04A

On 6 October 1979 the solar wind pressure increased suddenly causing earthward motion of the magnetopause in past 6.6 R sub e. Large amplitude variations in the magnetosheath magnetic field intensity with a quasi-period of 10 seconds were observed. Nearly static structures of high-beta plasma associated with the magnetic field minima and low-beta plasma associated with the magnetic field maxima were observed convecting toward the Earth. Flux transfer events were observed at the magnetopause with the same time scale and amplitude as the magnetosheath magnetic field variations in the southward magnetosheath magnetic field. No flux transfer events were observed during an extended period of northward magnetosheath magnetic field. The morphology of charged particle data for the transition between the magnetosphere and the magnetosheath for a northward magnetosheath magnetic field is presented. A trapped component was observed in the magnetosheath plasma during both northward and southward magnetosheath magnetic fields. It is concluded that flux transfer events result from the interaction of the earthward convecting plasma filaments with magnetospheric magnetic field at the magnetopause. GRA

N87-22576# Maryland Univ., College Park. Dept. of Mathematics.
HOC (HIGHER ORDER CROSSINGS) ANALYSIS OF THE EARTH'S POLAR MOTION FROM 1978 TO 1983 Report, 1 Jan. 1978 - 31 Dec. 1983
Benjamin Kedem and James Troendle Dec. 1986 25 p
(Grant AF-AFOSR-0187-82)
(AD-A177169; AFOSR-87-0115TR) Avail: NTIS HC A02/MF A01 CSCL 08E

This note reports the results of a new type of analysis applied to detect periodicities associated with the polar motion of the Earth. This method combines zero crossing counts with linear filtering to suggest a few good points in the spectral support at which the periodogram is evaluated. These points are selected by the sequence of higher order crossings commonly referred to as HOC. HOC are zero crossing counts observed in filtered series where the filtering consists mostly of simple repeated differencing, repeated summation and other lowpass filters. The application of HOC analysis in the detection of hidden periodicities has been discussed using both real and simulated data showing that this method is capable of fine detection of sinusoidal components buried in noise. GRA

N87-22577# Harvard Univ., Cambridge, Mass. Lab. of Physics.
BOUNDS ON GALACTIC COLD DARK MATTER PARTICLE CANDIDATES AND SOLAR AXIONS FROM A Ge-SPECTROMETER
Graciela Gelmini Nov. 1986 14 p Presented at the Quarks and Galaxies: Theoretical Workshop on Cosmology and Particle Physics, Berkeley, Calif., 28 Jul. 1986 Prepared in cooperation with Chicago Univ., Ill.
(Contract DE-AC02-82ER-40073)
(DE87-004575; CONF-860720-2) Avail: NTIS HC A02/MF A01

The ultralow background Ge spectrometer developed by the USC/PNL group is used as a detector of cold dark matter candidates from the halo of our galaxy and of solar axions (and other light bosons), yielding interesting bounds. Some of them are: heavy standard Dirac neutrinos with mass 20 GeV less than or equal to m less than or equal to 1 TeV are excluded as main components of the halo of our galaxy; Dine-Fischler-Srednicki axion models with F/2x sub e prime less than or equal to 0.5 x 10 to the 7th power GeV are excluded. DOE

N87-22578# Technische Univ., Munich (West Germany). Physikdepartment.
ON THE MEASUREMENT OF (SUP)107 Ag/(SUP)109 Ag RATIOS IN METEORITES
W. Kutschera, T. Faestermann, A. Gillitzer, and G. Fortuna (Istituto Nazionale di Fisica Nucleare, Legnaro, Italy) 1986 13 p Presented at the International Workshop on Techniches in Accelerator Mass Spectrometry, Oxford, Engl., 30 Jun. 1986 Prepared in cooperation with Istituto Nazionale di Fisica Nucleare, Legnaro (Italy)
(Contract W-31109-eng-38)
(DE87-004971; CONF-8606257-1) Avail: NTIS HC A02/MF A01

The detection of stable Ag isotopes in meteorites at the ppB level was attempted in an AMS experiment using the Munich MP tandem accelerator in conjunction with a time-of-flight detection system. The sensitivity of detecting Ag at this level was established by observing a counting rate of 17 ions of Ag-105/sec from a Au sample, which had been spiked with the radioisotope Ag-105(T/sub 1/2/ = 41 d) at a concentration of 1.0 ppB. A blank Ta sample gave no Ag-105 counts in 13 min, which corresponds to a detection limit of 7.5 x 10 to the -5 ppB. Although this sensitivity was clearly sufficient to perform Ag-107 and Ag-109 measurements in the desired concentration range, experiments with these isotopes were hampered by a currently irreducable background of stable Ag in the ppM range, possibly originating from the ion source itself. Indications of extraordinarily high Ag concentrations, far above this background, were observed in some of the investigated meteorites, but conclusions on their actual existence must await a better understanding of the origin of the general Ag background. DOE

N87-22579*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF THE GIACOBINI-ZINNER BOW WAVE
E. J. Smith, J. A. Slavin, S. J. Bame, M. F. Thomsen, S. W. H. Cowley, I. G. Richardson, D. Hovestadt, F. M. Ipavich, K. W. Ogilvie, and M. A. Coplan (Maryland Univ., College Park.) 1986 6 p Presented at the 20th ESLAB Symposium, Heidelberg, West Germany, 27 Oct. 1986 Sponsored by NASA and, in part, by DOE
(Contract W-7405-eng-36)
(NASA-CR-180515; NAS 1.26:180515; DE87-005121; LA-UR-87-40; CONF-8610207-7) Avail: NTIS HC A02 CSCL 03B

The cometary bow wave of P/Giacobini-Zinner has been analyzed using the complete set of ICE field and particle observations to determine if it is a shock. Changes in the magnetic field and plasma flow velocities from upstream to downstream have been analyzed to determine the direction of the normal and the propagation velocity of the bow wave. The velocity has then been compared with the fast magnetosonic wave speed upstream to derive the Mach number and establish whether it is supersonic, i.e., a shock, or subsonic, i.e., a large amplitude wave. The various measurements have also been compared with values derived from a Rankine-Hugoniot analysis. The results indicate that, inbound, the bow wave is a shock with M = 1.5. Outbound, a subsonic Mach number is obtained, however, arguments are presented that the bow wave is also likely to be a shock at this location. DOE

N87-22580 Pennsylvania Univ., Philadelphia.
ASTROPHYSICAL AND ATMOSPHERIC NEUTRINOS Ph.D. Thesis
Haeshim Lee 1986 117 p
Avail: Univ. Microfilms Order No. DA8624008

Haeshim Lee 1986 117 p
Avail: Univ. Microfilms Order No. DA8624008

The low energy (less than 200 MeV) atmospheric neutrino flux is calculated by a three-dimensional Monte Carlo cascade in order to estimate the backgrounds for low energy astrophysical neutrino detections. It is found that the atmospheric neutrino flux is a significant background and allows only a narrow neutrino astronomy window at 14 to 30 MeV for the continuous flux of neutrinos from relic supernova explosions. Calculation includes the geomagnetic latitude dependence of detector site and the angular dependence of neutrino detection direction as an extension to the one-dimensional calculation for use in future neutrino oscillation experiments with atmospheric neutrinos. The atmospheric muon flux calculation, a by-product of this three-dimensional atmospheric neutrino calculation, agrees with the measurement at sea-level within 10% accuracy. Dissert. Abstr.

N87-22581 Pennsylvania Univ., Philadelphia.
THE EFFECTS OF NEUTRINO TRANSPORT ON THE COLLAPSE OF IRON STELLAR CORES Ph.D. Thesis
Eric Stephen Myra 1986 120 p
Avail: Univ. Microfilms Order No. DA8624016

A multigroup flux-limited diffusion approximation to neutrino transport, correct to first order in material velocities, is developed and the neutrino-matter interactions important to stellar collapse are described. Applied as part of a hydrodynamic computer simulation using the Illinois equation of state, stellar collapse has been calculated for a variety of initial conditions and input physics. We report here on a comparison between iron cores of medium and high mass. We also study the role of neutrino-electron scattering in determining the amount of electron capture and neutrino loss from the core. In order to model this inelastic scattering, a modified Fokker-Planck approximation is used, in which adjacent neutrino energy groups are coupled. Such a treatment is numerically efficient and leads to the same final results as more accurate calculations of the same process. The moderate deleptonization obtained during infall (the lepton fraction Y sub L = 0.33x0.38 at core bounce) restricts homologous core masses to less than 0.8 solar mass. With 0.6 to 0.8 solar mass of outer core to traverse, nuclear dissociation alone stalls the shock waves produced at core bounce. In addition, neutrino energy losses remove at least another 4 x 10 to the 51st power ergs. In no case is matter ejected promply as a direct result of the initial shock wave. Dissert. Abstr.

N87-22582 California Inst. of Tech., Pasadena.
PARTIALLY COHERENT WAVE SCATTERING AND RADIATIVE TRANSFER: AN INTEGRAL EQUATION APPROACH Ph.D. Thesis
Run-Lie Shia 1986 123 p
Avail: Univ. Microfilms Order No. DA8623954

A new formalism for partially coherent wave scattering in a random medium is developed. In this formalism the coherent wave is the solution of a phenomenological wave equation, and the mutual coherence function of the wave field satisfies a simple integral equation. Using this formalism, the Peierls equations can be readily derived. A simple problem is solved to find the mutual coherence function produced by a laser beam in the atmosphere. The problem of multiple scattering of nonpolarized light in a planetary body of arbitrary shape illuminated by a parallel beam is formulated using the integral equation approach. The analysis reveals a direct ralation between the microscopic symmetry of the phase function for each scattering event and for the entire planet body, and the intimate connection between these symmetry relationships and the variational principle. Dissert. Abstr.

N87-22583 Pennsylvania State Univ., University Park.
MASSIVE SCALAR PARTICLE EMISSION FROM SCHWARZSCHILD BLACK HOLES Ph.D. Thesis
Richard David Simkins 1986 341 p
Avail: Univ. Microfilms Order No. DA8623802

A study was undertaken to study the absorption coefficients (or partial scattering cross-sections) of massive, scalar modes of

Hawking radiation emanating from Schwarzschild black holes. This was accomplished by using various variable and constant stepwise techniques whose results are later compared. All techniques are applied to the initial value problem associated with the system of two first-order ordinary differential equations derived from separating the Klein-Gordon wave equation in a Kerr-Newman geometry into radial and angular second-order differential equation; and all use the same JWKB-approximated starting values and asymptotic forms of the system's solutions. The approach to the problem that was used involves elements both of the thermodynamic and of the scattering pictures of black hole emission. The partial scattering cross sections are compared both with one another and with the previously known massless, scalar field counterparts. Periodicity, amplitude, and general behavior of total absorption cross section are viewed across the modal mass spectrum, with particular attention to their variation from the previously known counterparts of the massless, scalar parts.
Dissert. Abstr.

N87-22584# Illinois Univ., Urbana-Champaign.
A STUDY ON THE EFFECT OF GALACTIC ATMOSPHERES ON SHOCK INDUCED DISRUPTION OF EXTRAGALACTIC JETS Ph.D. Thesis
Dean Matthew Sumi 1986 266 p
Avail: Univ. Microfilms Order No. DA8623422

The interaction of collimated outflows of gas, or beams, from the nuclei of elliptical galaxies with the gas medium surrounding these galaxies is studied. In particular, the distribution of the gas medium around galaxies at rest with respect to the gas is explored. In this case, the density and temperature of the gas varies spatially and their relationship will be determined by the energy balance of the gas in the gravitational potential defined by the galaxy. The gas environment of an atmosphere around a galaxy can be described either as an outflowing wind, in the case where heating dominates, or a cooling inflow, in the case where cooling dominates. The response of a beam progagating through a cooling inflow atmosphere is found to be very different from the response of a beam in a wind atmosphere. In the former case, the beam can make a transition from a regime where the beam is dominated by biconical shocks into a regime where the beam is dominated by planar shocks. A beam initially in the biconical shock regime propagating in a wind atmosphere does not make this transition. The transition is caused by inversion of the temperature and pressure distributions found in cooling inflows and the beam length before this transition occurs is dependent on the March number and the ratio of the beam density to the external medium.
Dissert. Abstr.

N87-22585*# Toledo Univ., Ohio.
THE SIZE DISTRIBUTION OF INSTELLAR GRAINS Final Technical Report
Adolf N. Witt 15 May 1987 9 p
(Grant NAGw-89)
(NASA-CR-180593; NAS 1.26:180593) Avail: NTIS HC A02/MF A01 CSCL 03B

Three major areas involving interstellar grains were investigated. First, studies were performed of scattering in reflection nebulae with the goal of deriving scattering characteristics of dust grains such as the albedo and the phase function asymmetry throughout the visible and the ultraviolet. Secondly, studies were performed of the wavelength dependence of interstellar extinction designed to demonstrate the wide range of grain size distributions naturally occurring in individual clouds in different parts of the galaxy. And thirdly, studies were also performed of the ultraviolet powered emission of dust grains in the 0.5 to 1.0 micron wavelength range in reflection nebulae. Findings considered of major importance are highlighted. E.R.

N87-22586 California Univ., Los Angeles.
FIELD REVERSING MAGNETOTAIL CURRENT SHEETS: EARTH, VENUS, AND COMET GIACOBINI-ZINNER Ph.D. Thesis
David John McComas 1986 206 p
Avail: Univ. Microfilms Order No. DA8702652

The field reversing magnetotail current sheets at Earth, Venus, and Comet Giacobini-Zinner are examined. In the near Earth study a new analysis technique is developed to calculate the detailed current density distributions within the cross tail current sheet for the first time. This technique removes the effects of a variable sheet velocity by inverting intersatellite timings between the co-orbiting satellites ISEE-1 and -2. Case studies of three relatively geomagnetically quiet crossings are made; sheet thicknesses and peak current densities are approx. 15,000 km and approx. 5.50 nA/square m. Current density distributions reveal a high density central region, lower density shoulders, and considerable fine structure throughout. In the Venus study another new analysis technique is developed to reconstruct the average tail configuration from a correlation between field magnitude and draping angle in a large statistical data set. The variability of the Venus tail data is explained in terms of flapping of the current sheet as the tail tries to maintain a pressure balance condition under variations in the upstream interplanetary magnetic field (IMF) angle and, therefore, magnetic fluxes in the two lobes. The average magnetic field configuration and consistent plasma properties are derived.
Dissert. Abstr.

N87-22587 Columbia Univ., New York.
ATOMIC AND MOLECULAR EXCITATION MECHANISMS IN THE INTERSTELLAR MEDIUM Ph.D. Thesis
Amiel Sternberg 1986 206 p
Avail: Univ. Microfilms Order No. DA8703094

The detailed infrared response of dense molecular hydrogen gas to intense ultraviolet radiation fields in photodissociation regions is presented. The thermal and chemical structures of photodissociation regions are analyzed, and the relationship between the emission by molecular hydrogen and trace atomic and molecular species is explored. The ultraviolet spectrum of radiation generated by cosmic rays inside dense molecular clouds is presented, and the resulting rates of photodissociation for a variety of interstellar molecules are calculated. The effects of this radition on the chemistry of dense molecular clouds are discussed, and it is argued that the cosmic ray induced photons will significantly inhibit the production of complex molecular species. It is argued that the annihilation of electrons and positrons at the galactic center may result in observable infrared line emission by atomic hydrogen. A correlation between the intensity variations of the 511 keV line and the hydrogen infrared lines emitted by the annihilation region is predicted. The observed infrared fluxes from compact infrared sources at the galactic center may be used to constrain theories of pair production there. Dissert. Abstr.

N87-22588 Washington Univ., Seattle.
IODINE-XENON AND OTHER NOBLE GAS STUDIES OF INDIVIDUAL CHONDRULES FROM THE CHAINPUR METEORITE Ph.D. Thesis
Timothy Dale Swindle 1986 236 p
Avail: Univ. Microfilms Order No. DA8703501

Samples of 15 chrondrules from the Chainpur meteorite were irradiated with neutrons and analyzed for the isotopic composition of the noble gases argon, krypton, and xenon. The primary purpose was to determine R sub 0, the ratio of radioactivity to stable I-127 at the time of closure to diffusion of xexon in the samples. This ratio can be used to determine relative ages if iodine was isotopically homogeneous in the early solar system. In addition, the noble gases can be used to determine absolute ages, initial Pu-244/U-238 ratios and abundances of several elements. Chainpur has a lower metallographic cooling rate than any equilibrated meteorite, so it may have undergone isotopic closure at lower temperatures (hence later times). This would be consistent with models of meteorite parent bodies involving either metamorphism in smaller planetesimals followed by rapid accretion or episodes of breakup and reaccretion. Another possibility is that the I-Xe system is more sensitive in unequilibrated meteorites such as Chainpur. Dissert. Abstr.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N87-22589# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
PERIODIC AMPLITUDE VARIATIONS IN JOVIAN CONTINUUM RADIATION Progress Report
W. S. Kurth, D. A. Gurnett, and F. L. Scarf (TRW Space Technology Labs., Redondo Beach, Calif.) 1 Dec. 1986 10 p Repr. from J. Geophys. Res., v. 91, no. A12, 1986 p 13,523 - 13,530
(Contract N00014-85-K-0404)
(AD-A176669) Avail: NTIS HC A02/MF A01 CSCL 03B

An analysis of periodic variations in the amplitude of continuum radiation near 3 kHz trapped in the Jovian magnetosphere shows structure with periods near both 5 and 10 horus. Contrary to a plausible initial idea, the continuum amplitudes are not organized by the position of the observer relative to the dense plasma sheet. Instead, there seem to be perferred orientations of system III longitude with respect to the direction to the sun which account for the peaks. This implies a clocklike modulation of the continuum radiation intensity as opposed to a searchlight effect. The importance of the dipole longitude solar wind alignment to the amplitude of the continuum radiation implies that the source region of the radiation is near the magnetopause and may indirectly tie the generation of the radio waves to the clocklike modulation of energetic electron fluxes from Jupiter. Author

N87-22590*# Hawaii Univ., Honolulu. Inst. for Astronomy.
A STUDY OF THE IO-ASSOCIATED PLASMA AND NEUTRAL SODIUM CLOUD Final Technical Report
Carl B. Pilcher and Dale P. Cruikshank 18 May 1987 10 p
(Grant NAGw-153)
(NASA-CR-180595; NAS 1.26:180595) Avail: NTIS HC A02/MF A01 CSCL 03B

Narrow-band interference filter images were obtained for the Io torus at the S II wavelengths of 6716, 6731 and at the wavelenght of the S III, 9532 spectrum. The purpose of these observations is to study the short term temporal behavior of the torus and to gain a better understanding of the systematic morphology of the torus. From these images, estimates were obtained for the electron and ion densities and ion temperatures as a function of longitude, latitude, radius from Jupiter, and time. From the analysis of images taken in 1983 and 1984, extremely sharp longitudinal variations in plasma density were detected, subcorotational velocities were measures in the torus plasma, the presence of an optical east-west brightness asymmetry was confirmed in the ion emissions, and longitudinal variations were detected in torus ion temperatures. B.G.

N87-22591# National Oceanic and Atmospheric Administration, Washington, D. C. Satellite Research Lab.
ESTIMATION OF BROADBAND PLANETARY ALBEDO FROM OPERATIONAL NARROWBAND SATELLITE MEASUREMENTS
James E. Wydick, Paul A. Davis (Research and Data Systems, Inc., Lanham, Md.), and Arnold Gruber Apr. 1987 40 p
(NOAA-TR-NESDIS-27) Avail: NTIS HC A03/MF A01

A scene independent algorithm for estimating broadband planetary albedo using NOAA/AVHRR narrowband satellite data is presented. Initial results from a radiative transfer model investigation are given, followed by empirical coefficients which were deduced through multivariant regression analysis of Nimbus-7/ERB broadband data and NOAA-7/AVHRR narrowband data. Planetary scenes were grouped into five major categories. Strong variations in the two channel AVHRR narrowband albedo observations were noted for different scene classifications which emphasize the potential error in using a single AVHRR channel 1 albedo determination as was historically done. It was found that while individual scene regressions have significantly different regression characteristics; they allow a single regression when all surfaces are taken together due to their natural albedo range. Scene independent coefficients relating to AVHRR narrowband channels 1 and 2 to ERB broadband were presented with an explained variance of 0.956. Individual scene analyses are also presented but the emphasis was the scene independent studies. The results presented should allow improved albedo calculations when one is limited to AVHRR narrowband data. Author

N87-21975# Joint Publications Research Service, Arlington, Va.
SPACECRAFT DATA AID IN DESCRIBING VENUS'S GEOLOGY
Valeriy Leonidovich Barsukov *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 71-85 Transl. into ENGLISH from Priroda (Moscow, USSR), no. 6, Jun. 1986 p 24-35 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

N87-21976# Joint Publications Research Service, Arlington, Va.
ATMOSPHERE OF VENUS: NEW FINDINGS
Vasiliy Ivanovich Moroz *In its* USSR Report: Space (JPRS-USP-87-001) 19 Feb. 1987 p 86-103 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow, USSR), no. 3, May - Jun. 1986 p 19-30 (For primary document see N87-21972 15-12)
Copyright Avail: NTIS HC A11/MF A01

N87-22108*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A LABORATORY MODEL OF PLANETARY AND STELLAR CONVECTION
J. E. Hart, J. Toomre, A. E. Deane, N. E. Hurlburt, G. A. Glatzmaier, G. H. Fichtl, F. Leslie, W. W. Fowlis, and P. A. Gilman (National Center for Atmospheric Research, Boulder, Colo.) *In its* Spacelab 3 Mission Science Review Feb. 1987 p 31-41 (For primary document see N87-22103 15-34)
Avail: NTIS HC A05/MF A01 CSCL 03B

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N87-22592 California Inst. of Tech., Pasadena.
DEVELOPMENT AND EVOLUTION OF MAGNETIC FIELDS IN ACTIVE REGIONS ON THE SUN Ph.D. Thesis
Dean-Yi Chou 1987 95 p
Avail: Univ. Microfilms Order No. DA8702487

The development and evolution of magnetic fields in new active regions on the Sun is investigated. The major observations are digital magnetograms of the line-of-sight component of magnetic fields made with the high sensitivity videomagnetograph at the Big Bear Solar Observatory, and H sub alpha filtergrams with the 1/4 A H sub alpha Zeiss filter. This thesis consists of three themes. First, the separation velocities of opposite polarities of 24 new bipoles are measured and compared with the theoretical values. The predicted velocities are higher than those observed. Second, the cooling time scale of growing sunspots is studied. The cooling time scale is defined and derived from the measurements of intensity and magnetic field strength of sunspots. The cooling time scales of the ten growing sunspots studied range from .05 to 9 hr. Also estimated is the cooling time scale from two models, the inhibition Model and the Alfven Wave Model, based on linear theory. Both models give cooling times of about 0.05 hr. Third, nonadiabatic effects in convective instabilities in thin flux tubes are examined. The convective instabilities in thin flux tubes are studied by including a nonadiabatic term. I find that a flux tube is convectively stable for any field strength. Dissert. Abstr.

N87-22593# Kiel Univ. (West Germany). Inst. fuer Reine und Angewandte Kernphysik.
THE NUMERICAL TREATMENT OF SOLAR PARTICLE DIFFUSION IN THE MAGNETIC FIELDS OF INTERPLANETARY SPACE Ph.D. Thesis [DIE NUMERISCHE BEHANDLUNG DER AUSBREITUNG SOLARER FLAREINDUZIERTER TEILCHEN IN DEN MAGNETISCHEN FELDERN DES INTERPLANETAREN RAUMES]
Wolfgang Schlueter 1985 154 p In GERMAN
(ETN-87-99351) Avail: NTIS HC A08/MF A01

The injection and diffusion of charged particles in interplanetary magnetic fields are discussed. The advantages of a numerical treatment of diffusion and transport models, where influences on particle diffusion and velocity are not taken into account, are assessed. Numerical treatment offers a solution for the transport equation and shows influences of the interplanetary magnetic field, pitch angle scattering, and the duration of solar injection on the equation. ESA

N87-22594# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
MATERIAL EJECTA IN A DISTURBED SOLAR FILAMENT
Michael A. Raadu, Jean-Marie Malherbe, Brigitte Schmieder, and Pierre Mein Dec. 1986 35 p
(TRITA-EPP-86-13; ISSN-0348-7539; ETN-87-99787) Avail: NTIS HC A03/MF A01

H alpha observations, using a multichannel subtractive double pass spectrograph were made of an active region filament which undergoes a sudden disappearance. The period of observation was from 10:45 UT to 13:30 UT on 22 June, 1981. Velocity and intensity fluctuations in H alpha were measured. The proper motions of ejecta were followed allowing their trajectories and vector velocities to be determined. To model the dynamics of ejecta, models using thermal or magnetic driving forces are compared. The most promising model explains the motion as the consequence of magnetic stresses acting on an isolated magnetized plasmoid in a diverging flux tube. ESA

N87-22595# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 508, DECEMBER 1986. PART 1: (PROMPT REPORTS). DATA FOR NOVEMBER 1986, OCTOBER 1986 AND LATE DATA
Helen E. Coffey, ed. Dec. 1986 120 p
(Contract N00014-86-F-0049)
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Solar-Geophysical Data Number 508, December 1986. Part 1 (prompt Reports). Data for November 1986, October 1986, and Late Data, has the following contents: Data for November 1986-(IUWDS Alert Periods (advance and worldwide), Solar activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for October 1986--(Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); and Late data--(Solar active regions September 1986, Solar radio emission, Cosmic ray measurements by neutron monitor, Geomagnetic indices, Calcium plage data May to June 1986). GRA

N87-22596# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 508, DECEMBER 1986. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JUNE 1986
Helen E. Coffey, ed. Dec. 1986 25 p
(Contract N00014-86-F-0049)
(PB87-147245; SGD-508-Pt-2; ISSN-0038-0911; LC-79-640375) Avail: NTIS HC A02/MF A01 CSCL 03B

Solar-Geophysical Data Number 508, December 1986. Part 2 (Comprehensive Reports), Data for June 1986, has the following contents: Detailed index for 1986; and Data for June 1986-(Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar X-ray radiation from GEOS satellite, Mass ejections from the Sun, Active promineces and filaments). GRA

N87-22597# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
SOLAR-TERRESTRIAL PREDICTIONS: PROCEEDINGS OF A WORKSHOP AT MEUDON, FRANCE, JUNE 18-22, 1984
P. A. Simon, ed., G. Heckman, ed., and M. A. Shea, ed. 1986 650 p Workshop held in Meudon, France, 18-22 Jun. 1984 Prepared in cooperation with AFGL, Hanscom AFB, Mass.
(PB87-153482) Avail: NTIS HC A99/MF A01 CSCL 03B

Solar-Terrestrial Predictions: Proceedings of a Workshop at Meudon, France, June 18-22, 1984, has the following contents: (1) Long-term solar forecasting; (2) Medium-term solar forecasting; (3) Short-term solar forecasting; (4) Geomagnetic activity and aurora forecast; (5) Ionospheric prediction; and (6) General topics. GRA

N87-22598# National Center for Atmospheric Research, Boulder, Colo.
DYNAMO THEORY FOR THE INTERFACE BETWEEN THE CONVECTION ZONE AND THE RADIATIVE INTERIOR OF A STAR Ph.D. Thesis
E. E. DeLuca 1986 231 p Prepared in cooperation with Colorado Univ., Boulder
(Grant NSF ATM-82-17015)
(PB87-153763; NCAR/CT-104) Avail: NTIS HC A11/MF A01 CSCL 03B

The thesis examines the possibility that the solar dynamo operates in a thin overshoot region between the convection zone and the radiative interior. Of particular interest is understanding the interplay of the magnetic fields and the induced velocity fields in this overshoot layer. A set of model equations in Cartesian geometry, which contain the essential physics for the dynamo were derived and both analytic and numerical solutions to the equations are presented. GRA

N87-22599# National Center for Atmospheric Research, Boulder, Colo.
SOLAR CHROMOSPHERE-CORONA TRANSITION REGION Ph.D. Thesis
D. T. Woods 1986 651 p Prepared in cooperation with Colorado Univ., Boulder
(Grant NSF ATM-82-17015)
(PB87-153771; NCAR/CT-105) Avail: NTIS HC A99/MF A01 CSCL 03B

Examined from a theoretical standpoint is the solar transition region which separates the hot, diffuse corona from the cool, dense chromosphere. The purpose of the thesis is to provide a detailed and fairly complete description of the transition region and the shortcomings of the theory of this region as known. For our purposes we define the transition region to be a region extending in temperature from 10,000 approx = or less than T approx = or less than 1,000,000 deg K. Based upon the observations, the authors find the transition region to be subdivided into a lower T approx = or less than 100,000 deg and upper (T approx = or less than 100,000 deg K) transition region. As we will discover, the theory for the transition region seems to be most inadequate in the lower transition region. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N87-22600 California Inst. of Tech., Pasadena.
THE ABUNDANCES OF ULTRAHEAVY ELEMENTS IN THE COSMIC RADIATION Ph.D. Thesis
Brian John Newport 1986 145 p
Avail: Univ. Microfilms Order No. DA8623944

Analysis of the data from the Heavy Nuclei Experiment on the HEAO-3 spacecraft has yielded the cosmic ray abundances of

odd-even element pairs with atomic number,Z, in the range 33 is equal to or less than A is equal to or less than 60, and the abundances of broad element groups in the range of 62 is equal to or less than Z is equal to or less than 83, relative to iron. These data show that the cosmic ray source composition in this charge range is quite similar to that of the solar system, provided an allowance is made for a source fractionation based on first ionization potential. The observations are inconsistent with a source material which is dominated by either r-process or s-process material, whether or not an allowance is made for first ionization potential. The abundances of secondary elements are consistent with the leaky box model of galactic propagation, implying a pathlength distribution similar to that which explains the abundances of nuclei with Z less than 29. Dissert. Abstr.

99 GENERAL

N87-22601# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
HIGHLIGHTS 87/1
Mar. 1987 51 p
Avail: NTIS HC A04/MF A01

Topics covered include: Greek contributions to aerospace research and development; Hellenic Air Force Technology Research Center; Research Center of Crete; enhancement of NATO flight test capability; winner of the von Karman Medal, 1986; role of research in the Hellenic arms industry; and the value of NATO to AGARD. B.G.

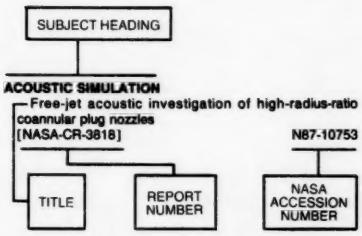
N87-22602*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LANGLEY AEROSPACE TEST HIGHLIGHTS - 1986
May 1987 101 p
(NASA-TM-89144; NAS 1.15:89144) Avail: NTIS HC A06/MF A01 CSCL 05A

The role of the Langley Research Center is to perform basic and applied research necessary for the advancement of aeronautics and space flight, to generate new and advanced concepts for the accomplishment of related national goals, and to provide research advice, technological support, and assistance to other NASA installations, other government agencies, and industry. This report highlights some of the significant tests which were performed during calendar year 1986 in Langley test facilities, a number of which are unique in the world. The report illustrates both the broad range of the research and technology activities at the Langley Research Center and the contributions of this work toward maintaining United States leadership in aeronautics and space research. Author

N87-22603# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
HIGHLIGHTS 86/2
Sep. 1986 43 p
Copyright Avail: NTIS HC A03/MF A01

Topics addressed include: the conceptual military framework; automatic data processing; AGARD telephone system; NATO scientific and technical information service; impact of electronic technological developments on air warfare; and Paris panorama. B.G.

Typical Subject Index Listing



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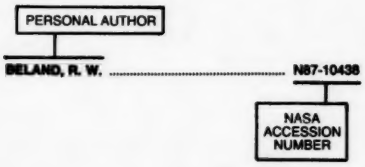

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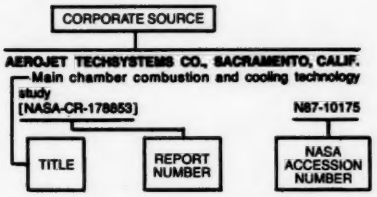

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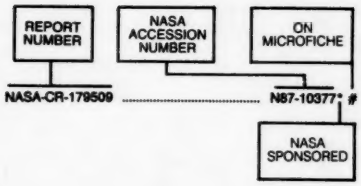

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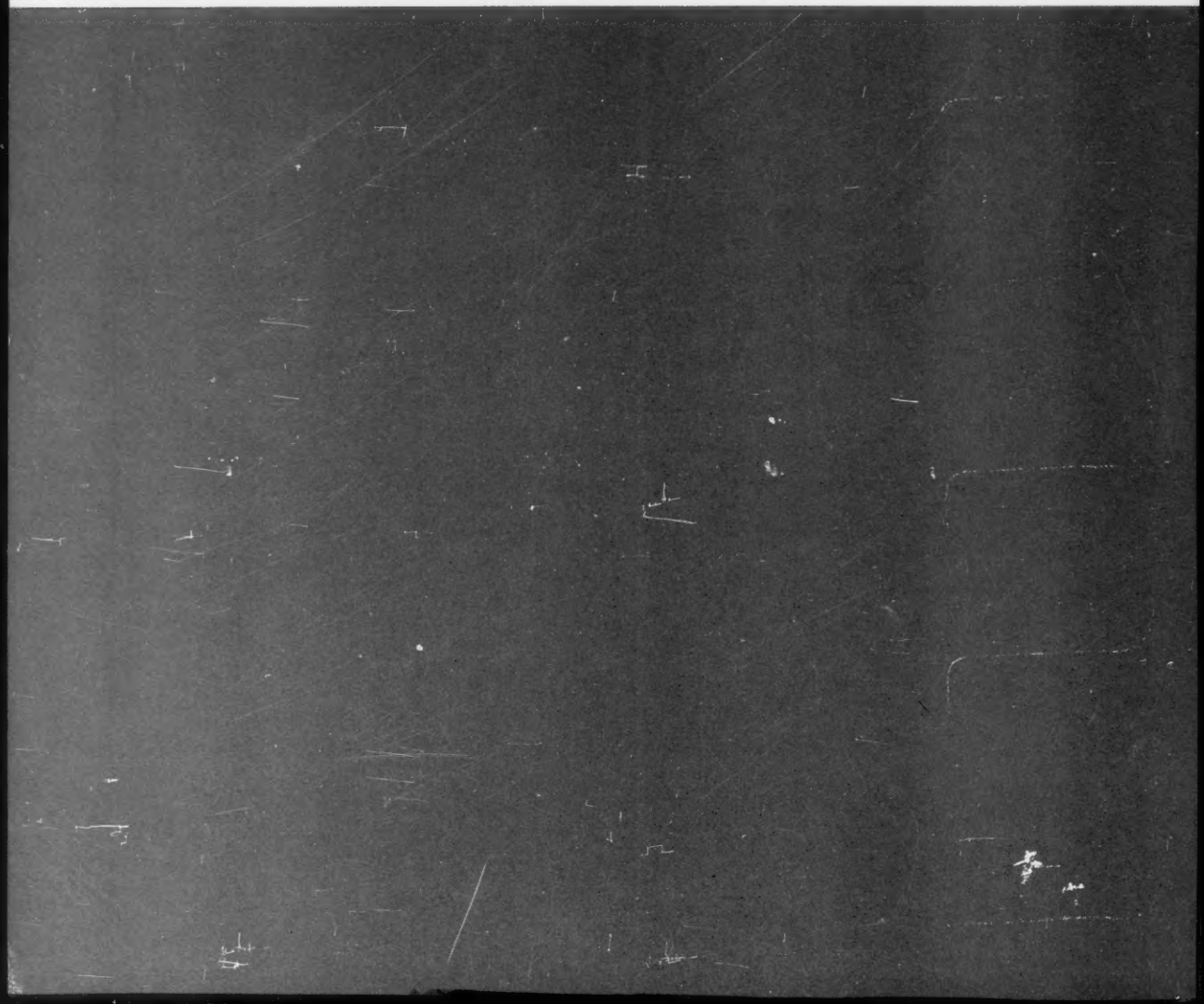
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